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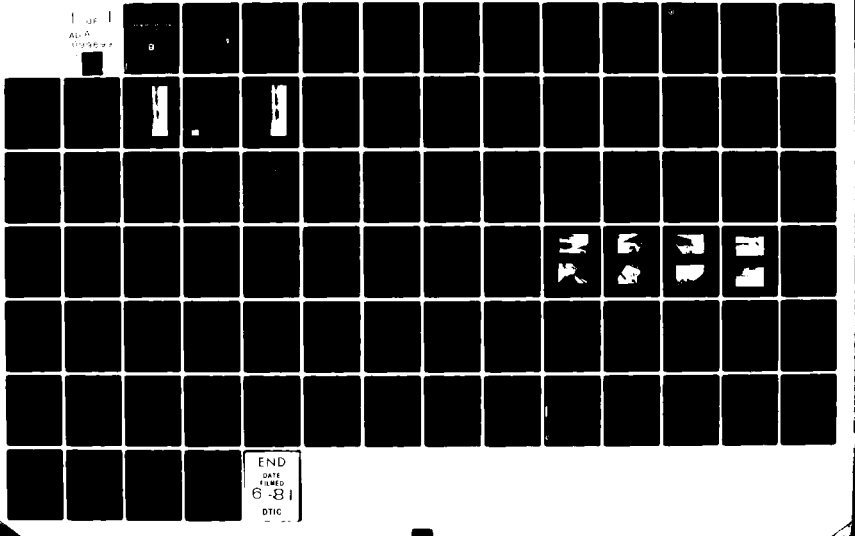

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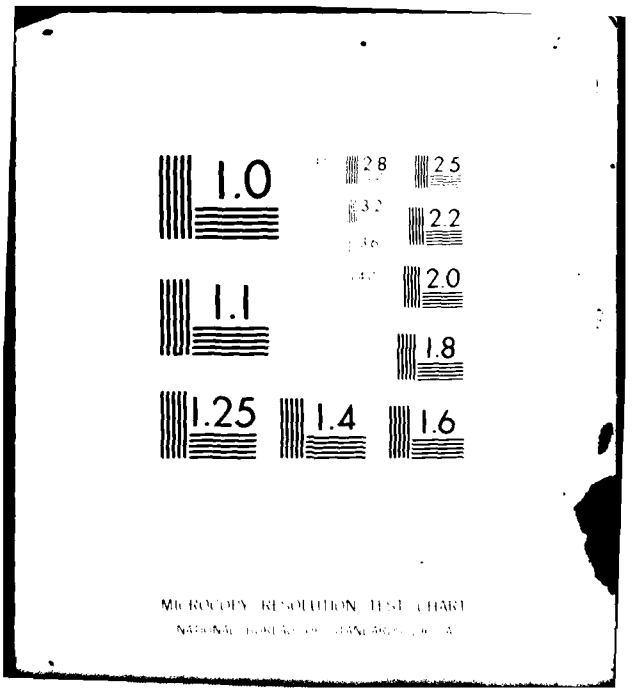
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DELAWARE RIVER BASIN,
LUBBERS RUN, SUSSEX COUNTY
NEW JERSEY

CRANBERRY LAKE DAM
NJ 00325

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DACW61-79-C-0011

DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

Rept. no. DAEN/NAP - 53842/NJ00325-81/03

MARCH 1981

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

(10) Peter / Yu

(19) REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

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National Dam Safety Program.
Cranberry Lake Dam, (NJ00325) Delaware River Basin, Lubbers Run
Sussex County, N.J.

5. TYPE OF REPORT & PERIOD COVERED
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7. AUTHOR(s)
Yu, Peter
Sussex County New Jersey. Phase I Inspection Report.

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DACW61-79-C-0011

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Langan Engineering Assoc. Inc.
990 Clifton Ave.
Clifton, NJ 07013

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS
NJ Department of Environmental Protection
Division of Water Resources
P.O. Box CN029
Trenton, NJ 08625

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Philadelphia, PA 19106

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15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)
Approved for public release; distribution unlimited.

DTIC ELECTE JUN 3 1981 D C

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES
Copies are obtainable from National Technical Information Service, Springfield, Virginia 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams	National Dam Safety Program	Riprap
Embankments	Spillways	Lubbers Run, N.J.
Visual Inspection	Outlet pipes	Cranberry Lake
Structural Analysis	Seepage	Dam, N.J.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)
This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE - 2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

22 MAY 1981

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, New Jersey 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Cranberry Lake Dam in Sussex County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Cranberry Lake Dam, a high hazard potential structure, is judged to be in poor overall condition. The spillway is considered seriously inadequate since a flow equivalent to 29 percent of the Probable Maximum Flood (PMF) would cause the dam to be overtopped. The seriously inadequate spillway is assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam could take place, significantly increasing the hazard of loss of life downstream from the dam. To ensure adequacy of the structure, the following actions, as a minimum, are recommended.

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within three months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. The following remedial measures should be initiated within three months from the date of approval of this report:

(1) Investigate the operating condition of the spillway sluice gate and the low level outlet pipe and valve. Repair and modify if necessary.

(2) Remove obstructions and debris in the discharge and downstream channel and provide means to prevent future accumulation of material.

(3) Investigate the backwater effect of the downstream abandoned railroad embankment, modify the outlet facilities or remove the embankment if necessary.

(4) Properly fill the existing animal burrow and provide means to prevent future animal burrowing in the embankment.

c. The following remedial measures should be initiated within six months from the date of approval of this report:

(1) Repair eroded areas of the embankment.

(2) Repair dislodged upstream riprap.

(3) Repair the cracked and spalled concrete of the spillway structure.

(4) Perform additional investigation to determine seepage conditions through and under the dam, the engineering properties of the dam and foundations, and whether or not conventional safety margins exist under more severe stress conditions than those observed during our inspection, and what modifications may be required to achieve such safety margins.

d. The following remedial actions should be initiated within one year from the date of approval of this report:

(1) Develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

(2) Properly remove all trees from the dam embankment and provide adequate filter coverage on the downstream face to prevent any piping which may occur as a result of future root decay.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman Courter of the Thirteenth District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release by this office, upon request, five days after the date of this letter.

NAPEN-N
Honorable Brendan T. Byrne

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Inspection Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

James G. Ton

1 Incl
As stated

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

Copies furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

CRANBERRY LAKE DAM (NJ00325)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 27 and 29 August, 17 September and 3 December 1980 by Langan Engineering Associates, Inc., under contract to the State of New Jersey. The State, under agreement with the U.S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Cranberry Lake Dam, a high hazard potential structure, is judged to be in poor overall condition. The spillway is considered seriously inadequate since a flow equivalent to 29 percent of the Probable Maximum Flood (PMF) would cause the dam to be overtopped. The seriously inadequate spillway is assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam could take place, significantly increasing the hazard of loss of life downstream from the dam. To ensure adequacy of the structure, the following actions, as a minimum, are recommended.

a. The spillway's adequacy should be determined by a qualified professional consultant engaged by the owner using more sophisticated methods, procedures and studies within three months from the date of approval of this report. Within three months of the consultant's findings remedial measures to ensure spillway adequacy should be initiated. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around the clock surveillance should be provided.

b. The following remedial measures should be initiated within three months from the date of approval of this report:

(1) Investigate the operating condition of the spillway sluice gate and the low level outlet pipe and valve. Repair and modify if necessary.

(2) Remove obstructions and debris in the discharge and downstream channel and provide means to prevent future accumulation of material.

(3) Investigate the backwater effect of the downstream abandoned railroad embankment, modify the outlet facilities or remove the embankment if necessary.

(4) Properly fill the existing animal burrow and provide means to prevent future animal burrowing in the embankment.

c. The following remedial measures should be initiated within six months from the date of approval of this report:

(1) Repair eroded areas of the embankment.

(2) Repair dislodged upstream riprap.

(3) Repair the cracked and spalled concrete of the spillway structure.

(4) Perform additional investigation to determine seepage conditions through and under the dam, the engineering properties of the dam and foundations, and whether or not conventional safety margins exist under more severe stress conditions than those observed during our inspection, and what modifications may be required to achieve such safety margins.

d. The following remedial actions should be initiated within one year from the date of approval of this report:

(1) Develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

(2) Properly remove all trees from the dam embankment and provide adequate filter coverage on the downstream face to prevent any piping which may occur as a result of future root decay.

APPROVED: _____

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 2 May 1981

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE—2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO
NAPEN-N

15 MAY 1981

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

Dear Governor Byrne:

This is in reference to our ongoing National Program for Inspection of Non-Federal Dams within the State of New Jersey. Cranberry Lake Dam (Federal I.D. No. NJ00325), a high hazard potential structure, has recently been inspected. The dam is owned by the Morris Canal and Banking Company, and is located on Lubbers Run in Cranberry Lake Township, Sussex County.

Using Corps of Engineers screening criteria, it has been determined that the dam's spillway is seriously inadequate because a flow equivalent to 29 percent of the Probable Maximum Flood would cause the dam to be overtopped. The seriously inadequate spillway is assessed as an UNSAFE, non-emergency condition, until more detailed studies prove otherwise, or corrective measures are completed. The classification of UNSAFE applied to a dam because of a seriously inadequate spillway is not meant to indicate the same degree of emergency as would be associated with an UNSAFE classification applied for a structural deficiency. It does mean, however, that based on an initial screening and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam could take place, significantly increasing the hazard potential to loss of life downstream from the dam. As a result of this UNSAFE determination, it is recommended that the dam's owners take the following measures within 30 days of the date of this letter:

a. Engage the services of a qualified professional consultant to more accurately determine the spillway adequacy by using more detailed and sophisticated hydrologic and hydraulic analyses, and to recommend any remedial measures required to prevent overtopping of the dam.

b. In the interim, a detailed emergency operation plan and downstream warning system should be promptly developed. Also, around the clock surveillance should be provided during periods of unusually heavy precipitation.

A final report on this Phase I Inspection will be forwarded to you within two months.

Sincerely,

JAMES C. TON
Colonel, Corps of Engineers
District Engineer

Copies Furnished:
Mr. Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

Mr. John O'Dowd, Acting Chief
Bureau of Flood Plain Regulation
Division of Water Resources
N.J. Dept. of Environmental Protection
P.O. Box CN029
Trenton, NJ 08625

UNSAFE DAM
NATIONAL PROGRAM OF INSPECTION OF DAMS

a. NAME: Cranberry Lake Dam

b. ID NO.: NJ00325

c. LOCATION State: New Jersey, County: Sussex.
River or Stream: Lubbers Run
Nearest D/S City or Town: Cranberry Lake

d. HEIGHT: 18 feet

e. MAXIMUM IMPOUNDMENT CAPACITY: 3225 ac. ft.

f. TYPE: Earthfill.

g. OWNER: Morris Canal and Banking Company

h. DATE GOVERNOR NOTIFIED OF UNSAFE CONDITIONS: 15 May 1981.

i. CONDITION OF DAM RESULTING IN UNSAFE ASSESSMENT: Preliminary report calculations indicate 29% of the PMF would overtop the dam.

l. URGENCY CATEGORY: High Hazard, UNSAFE, Non-Emergency.

j. DESCRIPTION OF DANGER INVOLVED: High Hazard potential, overtopping and failure of the dam would significantly increase hazard potential to loss of life and property downstream of dam.

m. EMERGENCY ACTIONS TAKEN:
Gov. notified of this condition by District Engineer's letter of 15 May 1981.

n. REMEDIAL ACTIONS TAKEN:
N.J.D.E.P. will notify dam's owner upon receipt of our letter.

k. RECOMMENDATIONS GIVEN TO GOVERNOR:
Within 30 days of the date of the District Engineer's letter the owner should do the following:
a. Engage the services of a qualified professional consultant to more accurately determine the spillway adequacy by using more detailed and sophisticated hydrologic and hydraulic analyses, and to recommend any remedial measures required to prevent overtopping of the dam.
b. In the interim, a detailed emergency operation plan and downstream warning system should be developed. Also, around the clock surveillance should be provided during periods of unusually heavy precipitation.

o. REMARKS: Final report, to be issued within six weeks, will have WHITE cover.

T.B. HEVERIN, Coordinator
Dam Inspection Program
U.S.A.E.D., Philadelphia

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

NAME OF DAM:	CRANBERRY LAKE DAM
ID NUMBER:	FED ID No NJ 00325
STATE LOCATED:	NEW JERSEY
COUNTY LOCATED:	SUSSEX
STREAM:	LUBBERS RUN
RIVER BASIN:	DELAWARE
DATE OF INSPECTION:	AUGUST, SEPTEMBER & DECEMBER 1980

ASSESSMENT OF GENERAL CONDITIONS

Cranberry Lake Dam, classified under high hazard potential category, is in poor overall condition. It is an earth fill dam approximately 18 feet high and 1000 ft long. The dam was reconstructed in 1927. The date of original construction and the extent of reconstruction are not known. Erosion of the embankments has occurred in numerous areas. Riprap has become dislodged and deteriorated in areas along the upstream embankment. The embankments are thickly vegetated with trees and brush. Animal burrow exists on downstream slope of the embankment. The ground at the downstream toe of the south embankment is wet and spongy. There are thin cracks and areas of deteriorating concrete on the spillway structure. The operational condition of the 12-in CIP valve is unknown. The downstream channel is obstructed by the abandoned railroad embankments and the discharge flow is limited by the two outlet pipes through the embankment. There is essentially no available information on the design, construction and operation of the dam. Additional investigation is necessary to adquately evaluate the future performance of the dam.

The spillway capacity as determined by Corps of Engineers Screening criteria is "seriously inadequate". The dam can adequately pass only 28% of the PMF. The spillway adequacy should be determined using more precise and sophisticated methods and procedures.

The following are recommended to be done very soon:

Investigate the operating condition of the spillway sluice gate and the low level outlet pipe and valve; repair and modify if necessary. Remove obstructions and debris in the discharge and downstream channel and provide means to prevent future accumulation of material. Investigate the backwater effect of the downstream abandoned railroad embankment, modify the outlet facilities or remove the embankment if necessary. Properly fill the existing animal burrow and provide means to prevent future animal burrowing in the embankment. The spillway of the dam is "seriously inadequate" as defined in the Corps of Engineers ETL 1110-2-234. The need for and type of mitigating measures should be determined, around-the-clock surveillance during periods of unusually heavy precipitation provided and a warning system established.

The following are recommended to be done soon:

Repair eroded areas of the embankment. Repair dislodged upstream riprap. Repair the cracked and spalled concrete of the spillway structure. Perform additional investigation to determine seepage conditions through and under the dam, the engineering properties of the dam and foundations, and whether or not conventional safety margins exist under more severe stress conditions than those observed during our inspection, and what modifications may be required to achieve such safety margins. Develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

The following is recommended to be done in the near future:

Properly remove all trees from the dam embankment and provide adequate filter coverages on the downstream face to prevent any piping which may occur as a result of future root decay.

K. Peter Yu, P.E.

OVERALL VIEW

CRANBERRY LAKE DAM

21 March 1981

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

NAME OF DAM:	CRANBERRY LAKE DAM
ID NUMBER.	FED ID No NJ 00325
STATE LOCATED:	NEW JERSEY
COUNTY LOCATED:	SUSSEX
STREAM:	LUBBERS RUN
RIVER BASIN:	DELAWARE
DATE OF INSPECTION:	AUGUST, SEPTEMBER & DECEMBER 1980

LANGAN ENGINEERING ASSOCIATES, INC.

Consulting Civil Engineers
990 CLIFTON AVENUE
CLIFTON, NEW JERSEY
201-472-9366

OVERALL VIEW

CRANBERRY LAKE DAM

21 March 1981

CONTENTS

NATIONAL DAM SAFETY REPORT

CRANBERRY LAKE DAM FED ID NO NJ 00325

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

SECTION 1 PROJECT INFORMATION

1.1 General

Authority to perform the Phase I Safety Inspection of Cranberry Lake Dam was received from the State of New Jersey, Department of Environmental Protection, Division of Water Resources by letter dated 12 August 1980. This Authority was given pursuant to the National Dam Inspection Act, Public Law 92-367 and by agreement between the State and the US Army Engineers District, Philadelphia.

The purpose of the Phase I Investigation is to develop an assessment of the general conditions with respect to safety of Cranberry Lake Dam and appurtenances based upon available data and visual inspection, and determine any need for emergency measures and conclude if additional studies, investigations and analyses are necessary and warranted. The assessment is made using screening criteria established in Recommended Guidelines for Safety Inspection of Dams prepared by the Department of Army, Office of the Chief of Engineers. It is not the purpose of the inspection report to imply that a dam meeting or failing to meet the screening criteria is, per se, certainly adaequate or inadequate.

1.2 Project Description

a. Description of Dam and Appurtances.

Cranberry Lake Dam is an earthfill dam, approximately 18 ft high and 1000 ft long. It has approximately 2H:1V slopes upstream and downstream. The upstream slope is riprapped with large angular boulders. The downstream slope has no visible riprap and is thickly vegetated with trees and brush. There is a 26 ft concrete broad crested weir spillway located at about the center of the dam. A concrete foot bridge, which is supported by the embankment spillway wing walls, exists over the discharge channel immediatley downstream of the spillway. A concrete apron exists in the channel from the spillway to the stream-bed about 25 ft downstream. There is a 2 ft x 2 ft gated sluiceway installed through the weir structure. The gate is located on the upstream side. A 12 inch diameter CI low level outlet pipe is reported to exist under the embankment approximately 44 ft south of the spillway. The valve control is reported to exist in a concrete chamber located on the downstream side of the embankment.

b. Location

Cranberry Lake Dam is located just west of Rt 206 in the Township of Cranberry Lake, Sussex County, New Jersey. It is located at north latitude 40° 57.0' and west longitude 74° 44.3'. A regional vicinity map is given in Figure 1.

c. Size Classification

Cranberry Lake Dam is classified as being "Intermediate" on the basis of its maximum reservoir storage volume of 3225 ac-ft which is less than 50,000 ac-ft but more than 1000 ac-ft. It is classified as "Small" on the basis of its maximum height of 18 feet which is less than 40 feet. The dam is therefore classified as "Intermediate" in size.

d. Hazard Classification

In the National Inventory of Dams, Cranberry Lake Dam has been classified as having "High Hazard Potential" on the basis that failure of the dam would cause excessive property damage to residences downstream and could potentially cause more than a few deaths. Based on the fact that there are houses built on top of the embankment at the south end of the dam, and visual inspections revealed that people utilize the woodland area immediately downstream for recreational purposes year-round, it is recommended to keep the Hazard Potential Classification as "High".

e. Ownership

The Cranberry Lake Dam is owned by the Morris Canal and Banking Company. The NJ DEP, Division of Forests and Parks, Labor and Industry Building, Room 806, Box 1420, Trenton, N. J. 08625 has been appointed Trustee for the lake and dam.

f. Purpose of Dam

The purpose of the dam is presently recreational.

g. Design and Construction History

Cranberry Lake Dam was rebuilt in 1927. The date of original construction and the extent of reconstruction are unknown.

Information concerning the design and construction of the original dam and subsequent reconstruction is unavailable.

h. Normal Operational Procedures

There are no operational procedures for Cranberry Lake Dam as reported by the NJ DEP, Division of Forests and Parks, Lake Hopatcong Regional Office.

1.3 Pertinent Data

a.	Drainage Areas	3.02 sq mi
b.	Discharge at Dam site	
	Maximum flood at dam site	Unknown
	Ungated spillway capacity at maximum pool elevation	894 cfs
c.	Elevation (ft. above MSL)	
	Top dam	763.8
	Maximum pool-design surcharge	Unknown

	Recreation pool	763.8 (Assumed to be top of spillway)
	Spillway crest	760.0
	Streambed at centerline of dam	Approximately 746.0 (Estimated)
	Maximum tailwater	Unknown
d.	Reservoir	
	Length of maximum pool	Approx 6600 ft
	Length of recreation pool	Approx 6200 ft
	Length of flood control pool	Approx 6600 ft (Assumed to be maximum pool)
e.	Storage (acre-feet)	
	Recreation pool	2457 ac-ft (Assumed to be spillway crest)
	Design surcharge	Unknown
	Top of dam	3225 ac-ft
f.	Reservoir Surface (acres)	
	Top dam	193 ac
	Maximum pool	193 ac (Assumed to be top of dam)
	Recreation pool	191 ac (Assumed to be spillway crest)
	Spillway crest	191 ac
g.	Dam	
	Type	Earth Embankment
	Length	Approx 1000 ft
	Height	18 ft max.

	Side Slopes	2H:1V w/large riprap upstream 2H:1V Downstream
	Zoning	Unknown
	Impervious Core	Unknown
	Cutoff	Unknown
	Grout curtain	Unknown
h.	Spillway	
	Type	Concrete ungated broad crested weir
	Length of weir	26 ft total, 24 ft unobstructed
	Crest elevation	760.00 MSL
	Gates	2 ft x 2 ft sluice gate thru concrete spillway
	U/S Channel	Concrete wing walls perpendicular to weir. No up-stream scour pad seen
	D/S Channel	Concrete wing walls perpendicular to weir with concrete scour pad
i.	Regulating Outlets	A 2 ft x 2 ft sluice gate thru the base of the spillway weir. Inv of sluice approx 755.5 MSL
		12" CI pipe thru embankment w/gate valve, located approx 44 ft south of spillway. Discharge inv of pipe El 746.9 Intake inv of pipe unknown

SECTION 2 ENGINEERING DATA

There is no information available concerning design, construction or operation of Cranberry Lake Dam. There are plans and profiles of the existing concrete spillway structure on file with the New Jersey Department of Environmental Protection, Division of Water Resources, Dam Application Number 22-72.

SECTION 3 VISUAL INSPECTION

The embankments of the dam are heavily vegetated with trees and brush. Many trees have trunk diameters greater than 8 inches. Erosion caused by numerous footpaths exist on both the upstream and downstream embankments. An animal burrow hole of about 2 feet in diameter was observed on the downstream slope of the south embankment. There is a berm approximately 10 feet wide existing along a portion of the downstream toe of the south embankment. The toe of the embankment just above the berm has been significantly eroded exposing the roots of the trees in some areas. The downstream area beyond the berm is wet and spongy. The riprap on the upstream face is becoming dislodged in areas. Fill has been placed and houses built on the southernmost end of the embankment.

Thin cracks and minor spalling exist on the concrete of the spillway structure. The sluiceway is partially obstructed by cobbles and gravel. The gate appears rusty as observed through the sluiceway from the downstream side. The discharge channel has accumulated wood, trash and other debris.

The concrete vault housing the control stem of the 12 inch diameter CI low level outlet valve is covered with heavily overgrown brush. It is reported that the operating condition of the valve was checked approx 5 years ago and found to be satisfactory. The present operating condition of the valve is unknown.

The shoreline of the reservoir is comprised of lawns and beaches of private residences, trees and rock outcrops.

The downstream channel is crossed by an abandoned railroad embankment about 200 ft from the spillway. As a result, a pond is formed upstream of the railroad embankment before the detained water discharges downstream by means of two 30-in dia. concrete pipes through the railroad embankment.

SECTION 4 OPERATIONAL PROCEDURES

Maintenance and operation of the Cranberry Lake Dam is by the New Jersey Department of Environmental Protection, Division of Parks and Forests, Lake Hopatcong Region. There are no operational procedures for the dam. No formal warning system appears to be in effect.

SECTION 5 HYDRAULIC/HYDROLOGIC

The hydraulic/hydrologic evaluation is based on a Spillway Design Flood (SDF) equal to the Probable Maximum Flood chosen in accordance with the evaluation guidelines for dams classified as high hazard and intermediate in size. Hydrologic design data for this dam is not available. The PMF has been determined by developing a synthetic hydrograph based on the maximum probable precipitation of 22.3 inches (200 sq mi - 24 hour). The Corps of Engineers has recommended the use of the SCS triangular unit hydrograph with the curvilinear transformation. Hydrologic computations are presented in Appendix 3. The PMF peak inflow determined for the subject watershed is 12751 cfs.

If the backwater effect from the downstream abandoned railroad embankment is not considered, the maximum capacity of the spillway is estimated to be 894 cfs which is significantly less than the SDF. Routing for the 1/2 PMF and PMF indicates the dam will overtop by 1.04 ft and 2.41 ft, respectively. The dam can adequately pass only 28% of the PMF.

Based on the fact that houses are located on the top of the embankment at the south end of the dam, the considerable storage of Cranberry Lake and our knowledge of the degree of overtopping potential, it is our opinion that dam failure from overtopping would significantly increase the hazard potential for excessive loss of life downstream from the dam from that which would exist just before overtopping failure.

The present drawdown structure consists of a 2 x 2 gated sluiceway and a 12" CI pipe with control valve as shown on plans. Drawdown of the reservior has been evaluated assuming that both drawdown structures are operable. Our calculations indicated that the lake level could be lowered 3 ft in approximately 7 days.

Further evaluation of the hydraulics of the dam should include an analysis of the effect of the backwater from the two-33 reduced to 30-in dia. pipes, which are the only discharge outlets through the railroad embankment located across the downstream channel.

SECTION 6 STRUCTURAL STABILITY

Based on visual observation, no immediate instability appears to exist in Cranberry Lake Dam under normal conditons. However, our visual examination of the dam revealed that erosion has been occurring in numerous areas. The ground beyond the downstream toe of the south embankment is wet and spongy. The embankments are thickly vegetated with trees and brush. The spillway discharge is seriously interferred by the downstream abandoned railroad embankment. A rapid drawdown on the downstream face of the dam will result in the event of a failure of the railroad embankment caused by excessive water retained in the low area between the two embankments.

No design or construction data is available for Cranberry Lake Dam, consequently analytical analyses of the dam cannot be made without gross assumptions concerning the properties of the materials used in the dam construction and foundation materials.

There are no operating procedures or records for Cranberry Lake Dam.

Cranberry Lake Dam is located in Seismic Zone I of the Seismic Zone Map of Contiguous States. As no information is available concerning the engineering properties of the foundation and dam materials, the degree of stability of the dam and appurtenances under more severe stress conditions than normal and its future performance cannot be evaluated without further investigation.

SECTION 7 ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment

Cranberry Lake Dam is in poor overall condition. It is an earth fill dam approximately 18 feet high and 1000 ft long. The dam was reconstructed in 1927. The date of original construction and the extent of reconstruction are not known. Erosion of the embankments has occurred in numerous areas. Riprap has become dislodged and deteriorated in areas along the upstream embankment. The embankments are thickly vegetated with trees and brush. Animal burrow exists on downstream slope of the embankment. The ground at the downstream toe of the south embankment is wet and spongy. There are thin cracks and areas of deteriorating concrete on the spillway structure. The operational condition of the 12-in CIP valve is unknown. The downstream channel is obstructed by the abandoned railroad embankments and the discharge flow is limited by the two outlet pipes through the embankment. There is essentially no available information on the design, construction and operation of the dam. Additional investigation is necessary to adquately evaluate the future performance of the dam.

The spillway capacity as determined by Corps of Engineers Screening criteria is "seriously inadequate". The dam can adequately pass only 28% of the PMF. The spillway adequacy should be determined using more precise and sophisticated methods and procedures.

7.2 Recommendations/Remedial Measures

The following are recommended to be done very soon:

1. Investigate the operating condition of the spillway sluice gate and the low level outlet pipe and valve. Repair and modify if necessary.

2. Remove obstructions and debris in the discharge and downstream channel and provide means to prevent future accumulation of material.

3. Investigate the backwater effect of the downstream abandoned railroad embankment, modify the outlet facilities or remove the embankment if necessary.

4. Properly fill the existing animal burrow and provide means to prevent future animal burrowing in the embankment.

5. The spillway of the dam is "seriously inadequate" as defined in the Corps of Engineers ETL 1110-2-234. The need for and type of mitigating measures should be determined, around-the-clock surveillance during periods of unusually heavy precipitation provided and a warning system established.

The following are recommended to be done soon:

1. Repair eroded areas of the embankment.

2. Repair dislodged upstream riprap.

3. Repair the cracked and spalled concrete of the spillway structure.

4. Perform additional investigation to determine seepage conditions through and under the dam, the engineering properties of the dam and foundations, and whether or not coventional safety margins exist under more severe stress conditions than those observed during our inspection, and what modifications may be required to achieve such safety margins.

5. Develop written operating procedures and a periodic maintenance plan to ensure the safety of the dam.

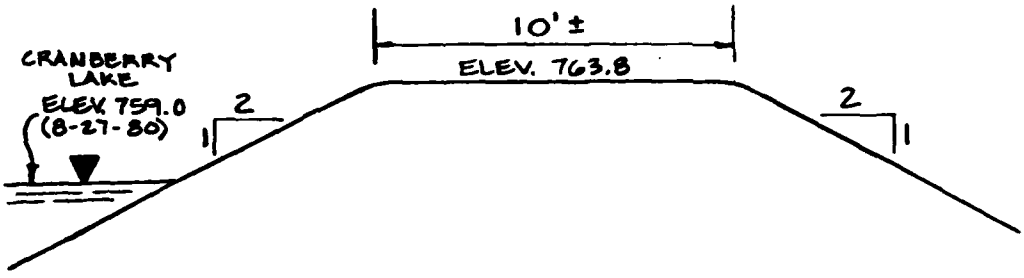
The following is recommended to be done in the near future:

1. Properly remove all trees from the dam embankment and provide adequate filter coverages on the downstream face to prevent any piping which may occur as a result of future root decay.

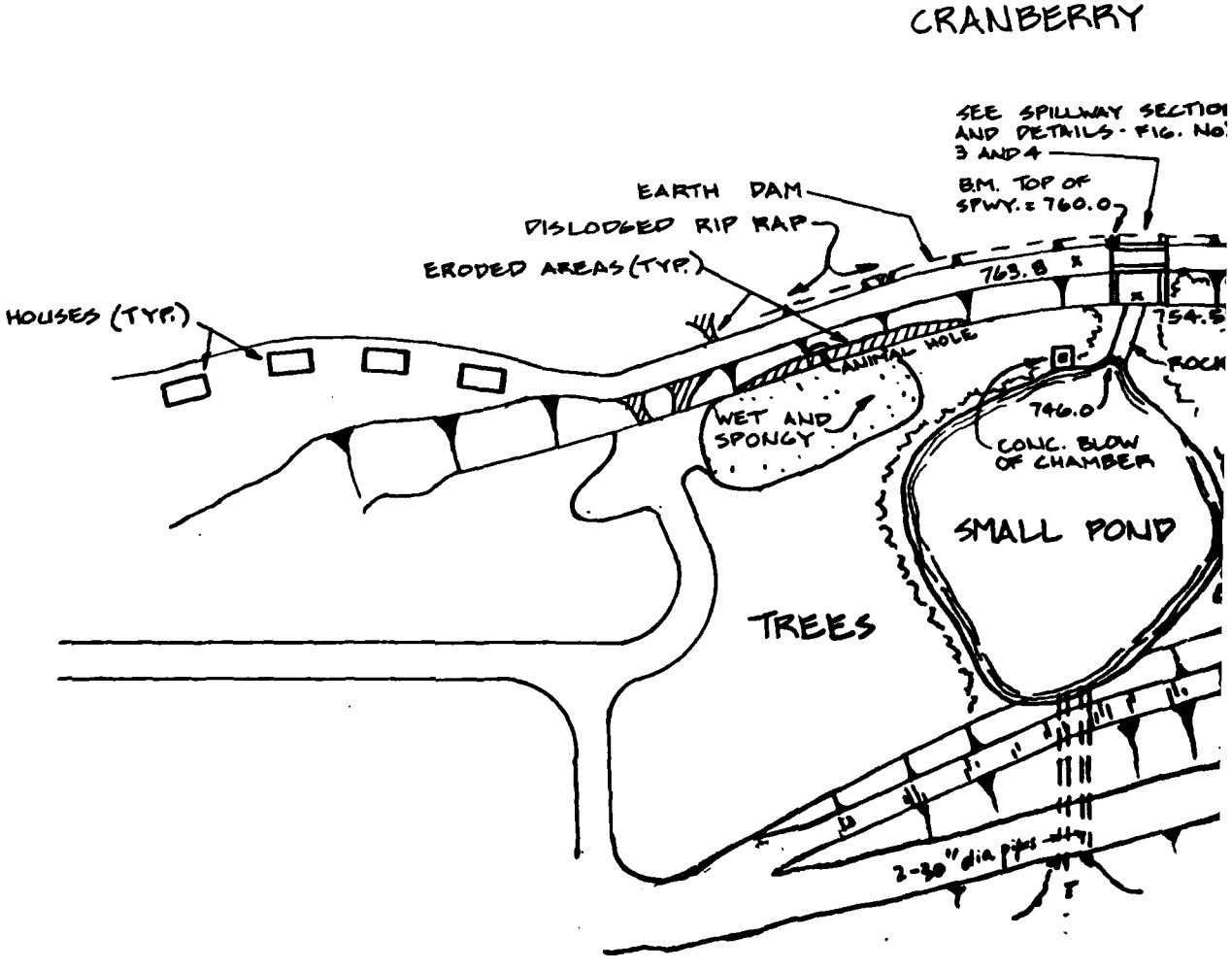
FIGURES

BY________ DATE ________ REGIONAL VICINITY MAP JOB NO. 80145

CKD________ DATE ________ CRANBERRY LAKE FIG 1



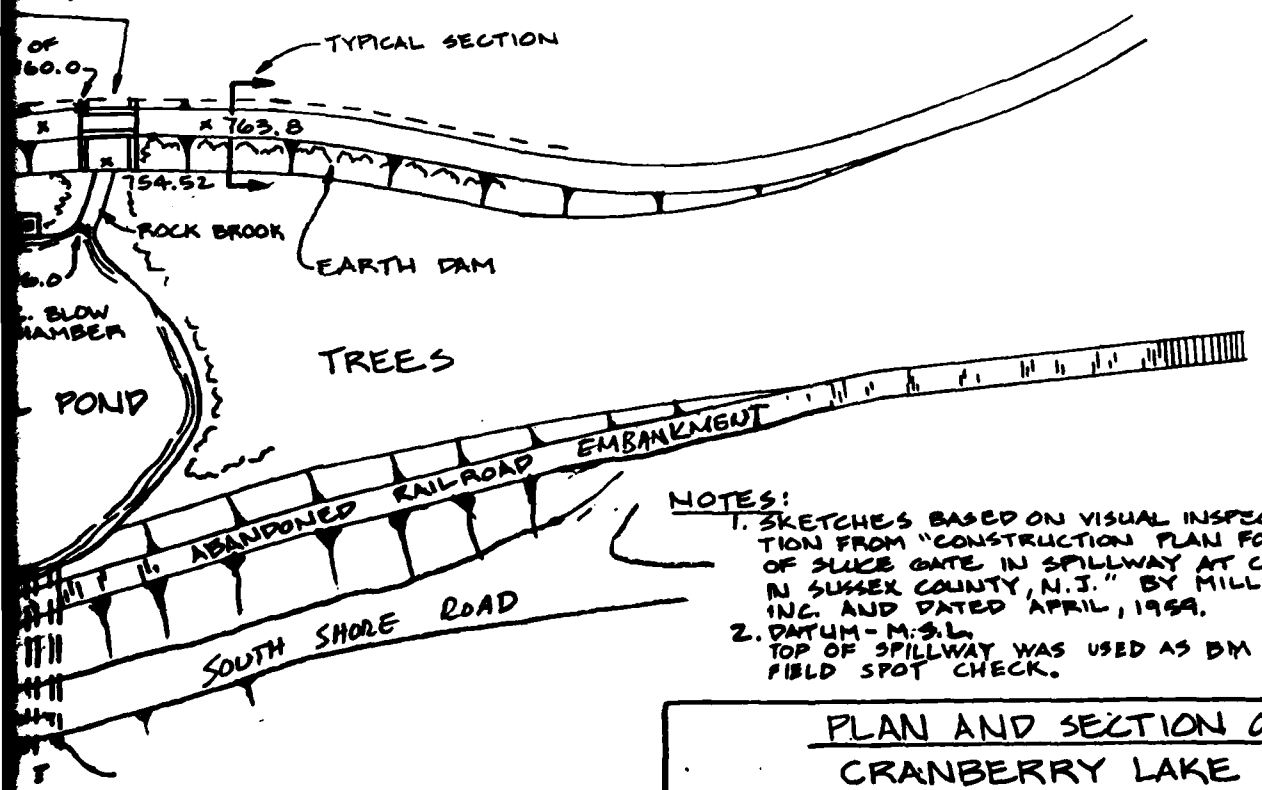
TYPICAL SECTION



PLAN

ERRY LAKE

LLWAY SECTION
TAILS - FIG. No:3



NOTES:
1. SKETCHES BASED ON VISUAL INSPECTION AND INFORMATION FROM "CONSTRUCTION PLAN FOR INSTALLATION OF SLUICE GATE IN SPILLWAY AT CRANBERRY LAKE IN SUSSEX COUNTY, N.J." BY MILLER & McGIFFERT, INC. AND DATED APRIL, 1959.
2. DATUM - M.S.L.
TOP OF SPILLWAY WAS USED AS BM AT EL 760.0 FOR FIELD SPOT CHECK.

PLAN AND SECTION OF DAM
CRANBERRY LAKE DAM

CRANBERRY LAKE — SUSSEX COUNTY, N.J.

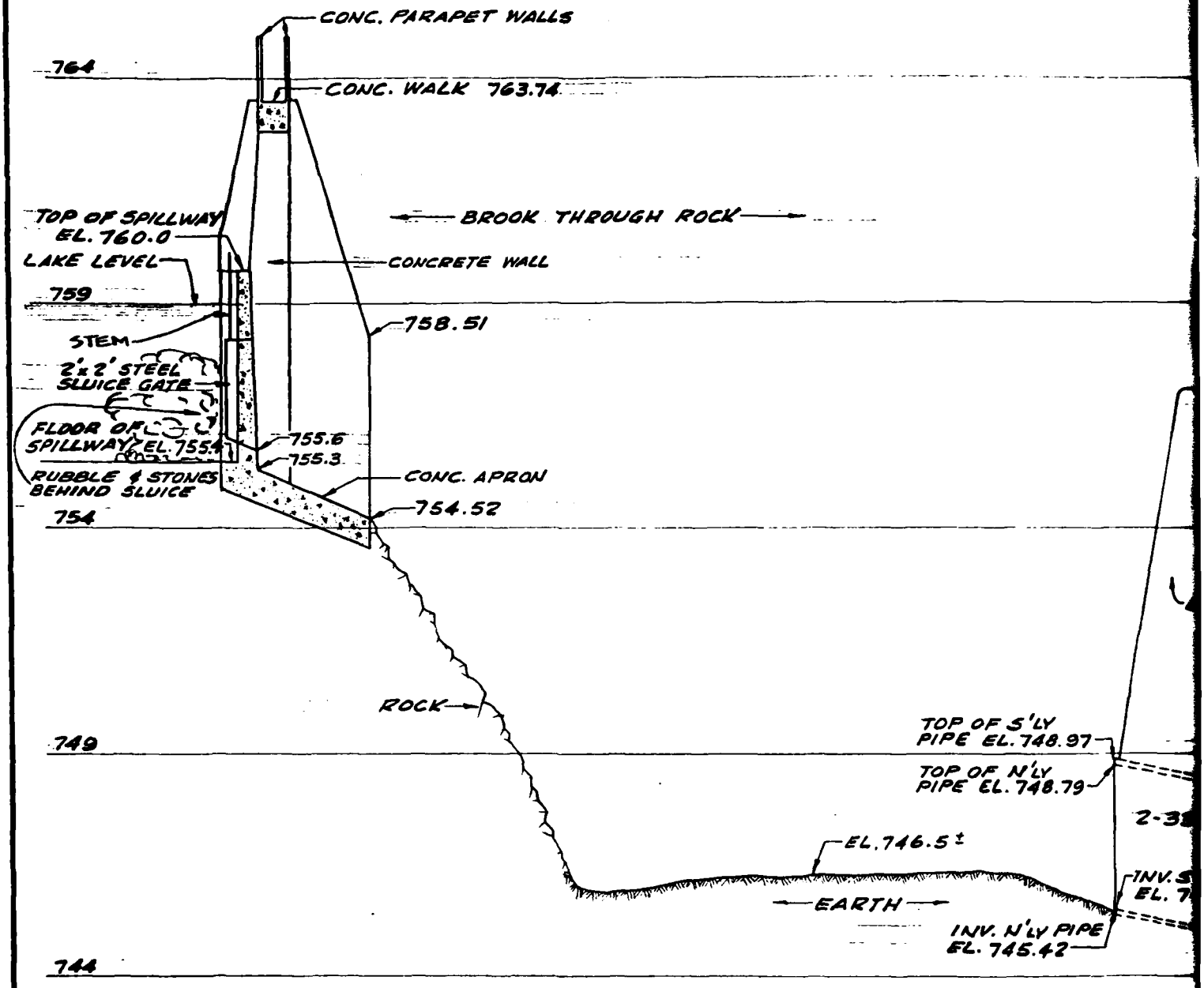
LANGAN ENGINEERING ASSOCIATES, INC.

990 CLIFTON AVENUE CLIFTON, N.J. 07013

DRN. BY: T.C.	SCALE: N.T.S.	JOB No. 80145
CK'D. BY: P.Y.	DATE: 2-19-81	FIG. No. 2

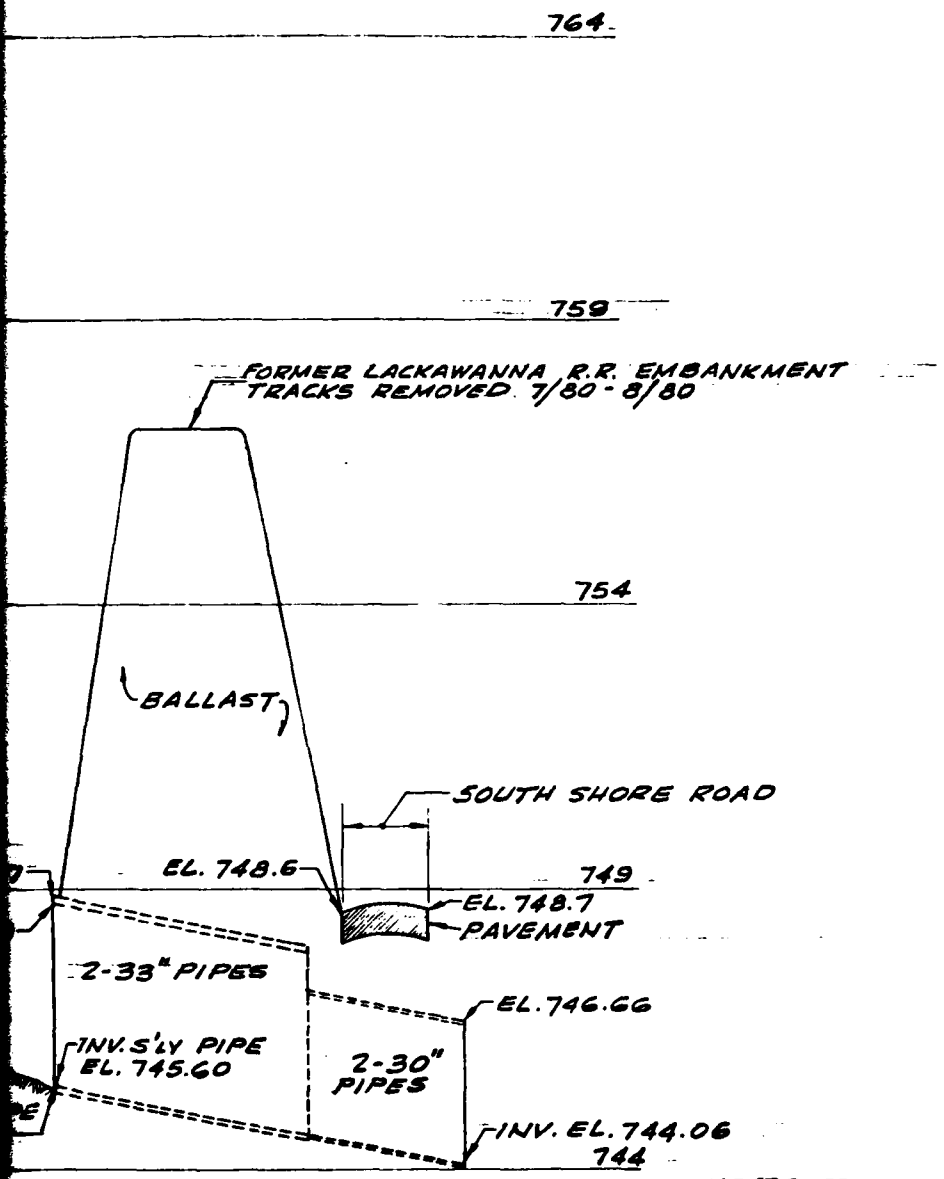
AN

1 2



SECTION THRU SPI

AND DOWNSTREAM CH



U. SPILLWAY

AM CHANNEL

NOTES:

1. SKETCHES ADAPTED FROM "CONSTRUCTION PLAN FOR INSTALLATION OF SLUCE GATE IN SPILLWAY AT CRANBERRY LAKE IN SUSSEX COUNTY, N.J." BY MILLER & McGIFFERT, INC. AND DATED APRIL, 1959.
2. DATUM = M.S.L.

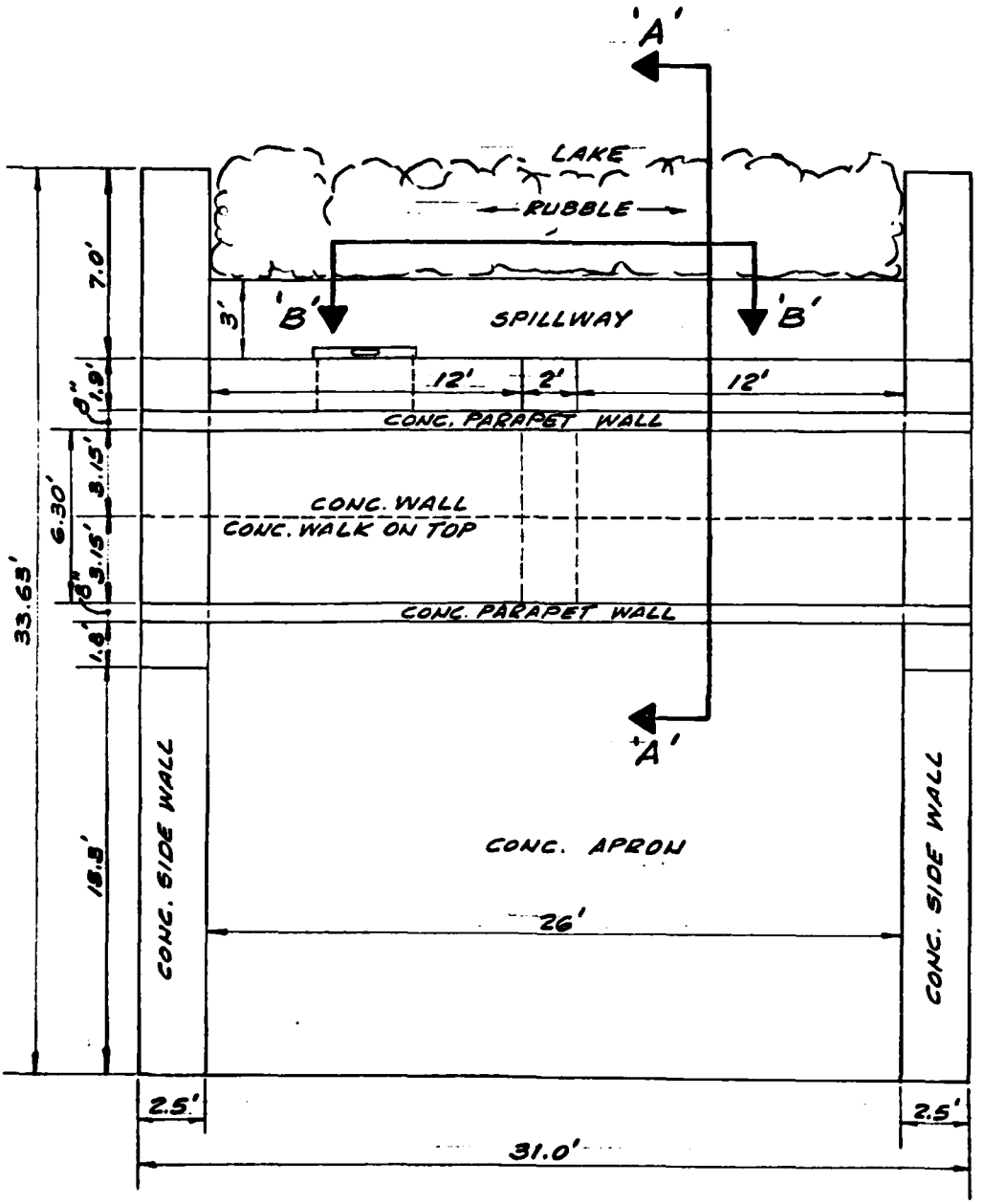
SECTION
CRANBERRY LAKE DAM

CRANBERRY LAKE ..... SUSSEX COUNTY, N.J.

LANGAN ENGINEERING ASSOCIATES, INC.

990 CLIFTON AVENUE CLIFTON, N.J. 07013

DRN. BY: R.D.	SCALE: N.T.S.	JOB No. 80145
CK'D. BY: V.U.	DATE: 9-5-80	FIG. No. 3



EL. 75

PLAN VIEW @ SPILLWAY

NOTES:
1. SKETCH
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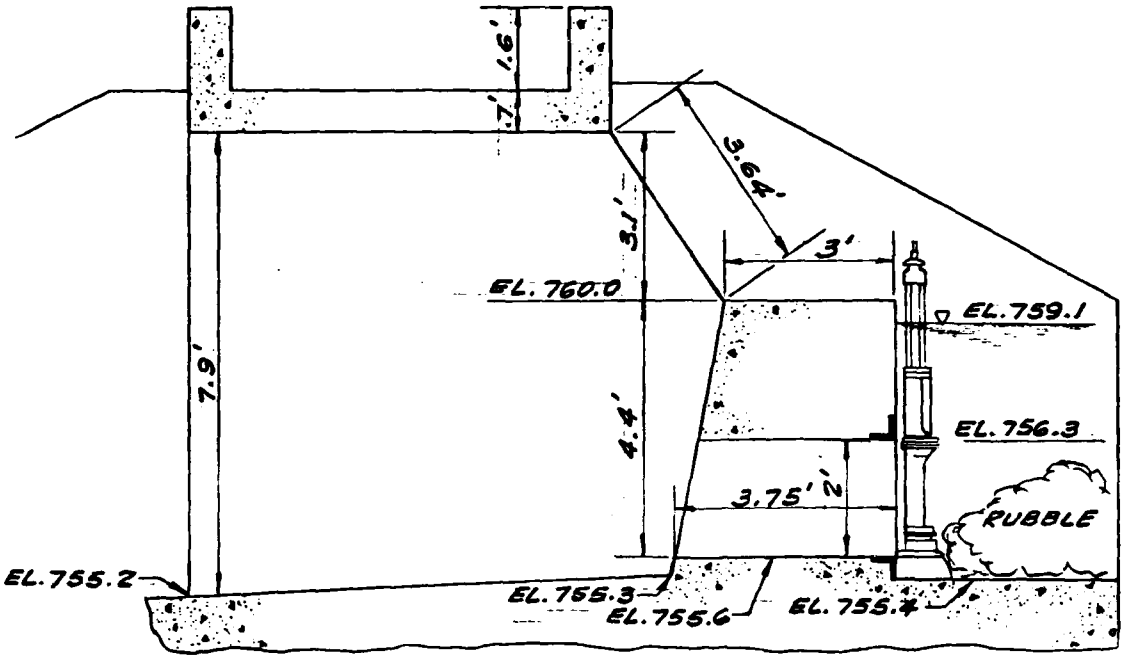
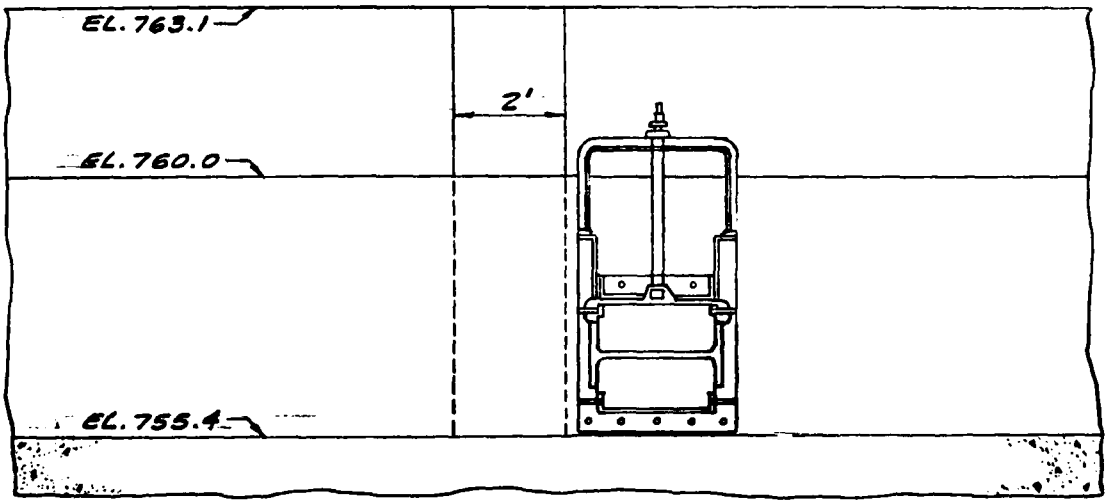
2. DATUM



SECTION 'A-A'



SECTION 'B-B'

NOTES:
1. SKETCHES ADAPTED FROM "CONSTRUCTION PLAN FOR INSTALLATION OF SLUICE GATE IN SPILLWAY AT CRANBERRY LAKE IN SUSSEX COUNTY, N.J." BY MILLER & McGIFFORT, INC. AND DATED ON APRIL, 1959.
2. DATUM - M.S.L.

SPILLWAY DETAILS
CRANBERRY LAKE DAM
CRANBERRY LAKE — SUSSEX COUNTY, N.J.

LANGAN ENGINEERING ASSOCIATES, INC.
990 CLIFTON AVENUE CLIFTON, N.J. 07013

DRN. BY: R.D.	SCALE: N.T.S.	JOB No. 80145
CK'D. BY: V.U.	DATE: 9-9-80	FIG. No. 4

APPENDIX 1

CRANBERRY LAKE DAM

1. CHECK LIST - HYDROLOGIC AND HYDRAULIC DATA
2. CHECK LIST - VISUAL INSPECTION
3. CHECK LIST - ENGINEERING DATA

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 3.02 sq. mi., woods & forest land, avg 2.2% slope

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 760 (2457 ac-ft)

ELEVATION TOP MAXIMUM POOL (STORAGE CAPACITY): 763.8 (3225 ac-ft)

ELEVATION MAXIMUM DESIGN POOL: 763.8 (Assumes top of dam)

ELEVATION TOP DAM: 763.8

CREST: Spillway

a. Elevation 760
b. Type broad crested trapezoidal weir
c. Width 3'
d. Length 24' (effective)
e. Location Spillover Approximately center of dam
f. Number and Type of Gates 1 - 2' x 2' sluice gate through weir

OUTLET WORKS:

a. Type 2 x 2 sluice gate
b. Location 8 ft North of South wing wall
c. Entrance inverts 755.6
d. Exit inverts 755.6
e. Emergency draindown facilities 12" CIP @ inv 746.9 (assumed elev.)

HYDROMETEOROLOGICAL GAGES: None known
a. Type
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: 894 cfs @ 763.8

Check List
Visual Inspection
Phase 1

Name Dam CRANBERRY LAKE DAM County SUSSEX State NJ Coordinators NJ DEP

Date(s) Inspection SEE BELOW Weather CLEAR (8/27/80) Temperature LOW 90's F (8/27/80)

Pool Elevation at Time of Inspection APPROX 759 M.S.L. (8/27/80) Tailwater at Time of Inspection NONE M.S.L.

Inspection Personnel:

R. W. GREENE 8/27/80
V. URBAN 8/27/80
D. J. LEARY 9/17/80 & 12/3/80
K. PETER YU 8/29/80 & 12/3/80

R. W. GREENE Recorder

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	NONE OBSERVED	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	NO CRACKS OBSERVED. GROUND AT TOE OF SOUTH EMBANKMENT WET AND SPONGY.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	EROSION CAUSED BY NUMEROUS FOOTPATHS ON BOTH UP & DOWN STREAM EMBANKMENTS. EROSION ALONG DOWNSTREAM TOE OF SOUTH EMBANKMENT JUST ABOVE BERM.	PROPERLY REPAIR ERODED AREA.
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	CREST RUNS ROUGHLY SOUTH & NORTH WITH SLIGHT REVERSE CURVE APPROXIMATELY 1000'. NO OBSERVABLE EVIDENCE THAT MOVEMENT HAS OCCURRED.	
RIPRAP FAILURES	AREAS OF DISLODGED RIPRAP ALONG TOP OF UPSTREAM EMBANKMENT.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
	EMBANKMENT NORTH AND SOUTH OF SPILLWAY HEAVILY VEGETATED WITH TREES & BRUSH. ANIMAL HOLE ABOUT 2-FT DIA. ON DOWNSTREAM SLOPE OF SOUTH EMBANKMENT	PROPERLY FILL ANIMAL HOLE AND REMOVE TREES AND ROOTS.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	*NO SIGN OF CRACKS, SEEPAGE OR MOVEMENT SEEN AT* ANY JUNCTIONS.	
ANY NOTICEABLE SEEPAGE	THERE ARE AREAS OF PONDED WATER AND SOFT SPONGY GROUND ALONG THE TOE OF THE SOUTH DOWNSTREAM EMBANKMENT.	
STAFF GAGE AND RECORDER	NONE OBSERVED.	
DRAINS	NONE OBSERVABLE.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	SLUICEWAY CONCRETE HAS NO CRACK & SPALL. 12" CI PIPE AND GATE INACCESSIBLE AND NOT INSPECTED.	TWO OUTLET WORKS 1. 2'x2' SLUICEWAY THROUGH SPILLWAY WEIR STRUCTURE 2. 12" GATED CI PIPE UNDER SOUTH EMBANKMENT. CLEAR ACCESS, PERFORM INSPECTION.
INTAKE STRUCTURE	NONE. INTAKE OF PIPE BELOW POOL ELEVATION.	NOT VISIBLE.
OUTLET STRUCTURE	CONCRETE VAULT HOUSING VALVE CONTROL FOR 12" CI PIPE. COVER ON VAULT. VAULT HEAVILY OVERGROWN WITH BRUSH.	OPERATING CONDITION OF VALVE UNKNOWN. REMOVE VEGETATION, PERFORM INSPECTION.
OUTLET CHANNEL	OUTLETS INTO POND DOWNSTREAM OF SPILLWAY. CHANNEL UNOBSTRUCTED.	
EMERGENCY GATE	2' x 2' SLUICE GATE APPEARED RUSTY AS VIEWED THROUGH SLUICEWAY FROM DOWNSTREAM SIDE.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	NO APPARENT DEFECTS OBSERVED.	
APPROACH CHANNEL	VERTICAL CONCRETE WING WALLS EXTENDING 4 FT UPSTREAM PERPENDICULAR TO WEIR. THE CONCRETE HAS A FEW THIN CRACKS AND SMALL AREAS OF SPALLING. CHANNEL UNOBSTRUCTED.	REPAIR CONCRETE.
DISCHARGE CHANNEL	CONCRETE APRON PAD AND VERTICAL WING WALLS EXTENDING APPROX 26 FT DOWNSTREAM. TRASH AND DEBRIS HAVE ACCUMULATED ON THE APRON. ROCKS, BOTTLES, CANS, SMALL BRANCHES, ETC. THIN CRACKS AND SPALLING OF CONCRETE WING WALLS.	DEBRIS SHOULD BE REMOVED. REPAIR CONCRETE.
BRIDGE AND PIERS	CONCRETE FOOT BRIDGE OVER SPILLWAY APPROX 6 1/2 FT WIDE BETWEEN PARAPETS, PARALLEL TO WEIR, APPROXIMATELY 3 FT ABOVE WEIR, SUPPORTED BY CENTER PIER AND WING WALLS.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	GENTLE, LOW RELIEF AROUND RESERVOIR, VARIABLE SLOPES. SLOPES COMPRISED OF LAWNS, WOODED AREAS AND ROCK OUTCROPS.	
SEDIMENTATION	COARSE GRAVEL, COBBLES & BOULDERS UPSTREAM OF SPILLWAY. NO FINES SEEN.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	CHANNEL PARTIALLY OBSTRUCTED BY TREES & MISCELLANEOUS DEBRIS BEYOND SPILLWAY APRON. IT IS FURTHER OBSTRUCTED BY RR EMBANKMENT APPROX 200 FT DOWNSTREAM AND DISCHARGE FLOW LIMITED BY 2 3-FT DIA. OUTLET PIPES.	RR ABANDONED, TRACKS REMOVED. INVESTIGATE THE BACKWATER AFFECT OF THE DOWNSTREAM EMBANKMENT. MODIFY THE OUTLET FACILITIES OR REMOVE THE EMBANKMENT IF NECESSARY.
SLOPES	GENTLE, HEAVILY WOODED.	
APPROXIMATE NO. OF HOMES AND POPULATION	NONE VISIBLE DOWNSTREAM. APPROXIMATELY 6 HOMES BUILT ON SOUTH END OF SOUTH EMBANKMENT.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	NO INFORMATION AVAILABLE
REGIONAL VICINITY MAP	SEE FIGURE 1
CONSTRUCTION HISTORY	NO INFORMATION AVAILABLE
TYPICAL SECTIONS OF DAM	NO INFORMATION AVAILABLE
HYDROLOGIC/HYDRAULIC DATA	NO INFORMATION AVAILABLE
OUTLETS - PLAN	12 INCH CI LOW LEVEL OUTLET WITH VALVE
- DETAILS	NO INFORMATION AVAILABLE
-CONSTRAINTS	NO INFORMATION AVAILABLE
-DISCHARGE RATINGS	NO INFORMATION AVAILABLE
RAINFALL/RESERVOIR RECORDS	NO INFORMATION AVAILABLE

ITEM	REMARKS
DESIGN REPORTS	NO INFORMATION AVAILABLE
GEOLOGY REPORTS	NO INFORMATION AVAILABLE
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	NO INFORMATION AVAILABLE
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	NO INFORMATION AVAILABLE
POST-CONSTRUCTION SURVEYS OF DAM	Inspection Report Cranberry Lake Dam and Spillway 21 September 1972 By: Storch Engineers Florham Park, N.J. Source: NJ DEP Div. of Water Resources Dam Application No 22-72
BORROW SOURCES.	NO INFORMATION AVAILABLE

ITEM	REMARKS
MONITORING SYSTEMS	NO INFORMATION AVAILABLE
MODIFICATIONS	CONSTRUCTION OF A 2 FT X 2 FT SLUICE AND GATE THROUGH THE SPILLWAY WEIR
HIGH POOL RECORDS	NO INFORMATION AVAILABLE
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	NO INFORMATION AVAILABLE
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	NONE REPORTED BY NJ DEP DIVISION OF LAKES AND FORESTS LAKE HOPATCONG REGION
MAINTENANCE OPERATION RECORDS	NO INFORMATION AVAILABLE

ITEM	REMARKS		
SPILLWAY PLAN SECTIONS DETAILS	SHOWN IN CONSTRUCTION PLAN FOR INSTALLATION OF SLUICE GATE IN SPILLWAY AT CRANBERRY LAKE, SUSSEX COUNTY, N.J. PREPARED FOR CRANBERRY LAKE COMMUNITY CLUB	PREPARED BY: MILLER & MCGIFFERT, INC., ENGINEERS 484 BLOOMFIELD AVE MONTCLAIR, NJ APRIL 1959	SOURCE NJ DEP DEPT. OF WATER RESOURCES DAM APPLICATION NO 22-7
OPERATING EQUIPMENT PLANS & DETAILS	2 FT X 2 FT SPILLWAY SLUICE GATE - SEE SPILLWAY PLAN 12 IN DIA. CI LOW LEVEL OUTLET - NO INFORMATION AVAILABLE		

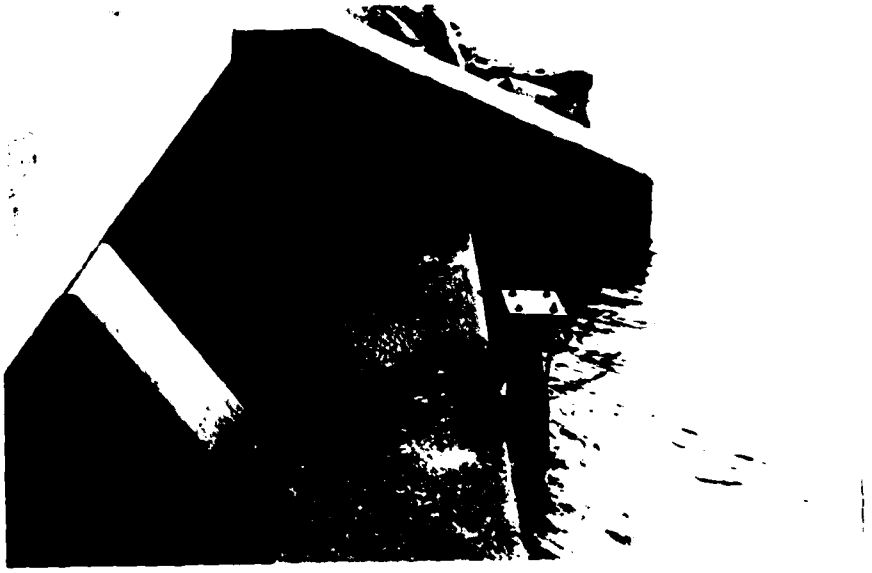
APPENDIX 2

PHOTOGRAPHS

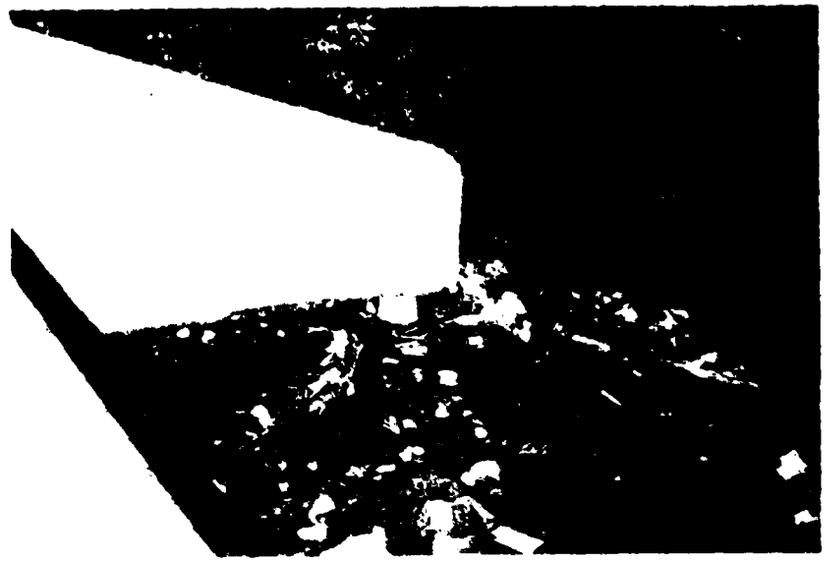
View of north upstream embankment taken from spillway bridge looking north. 27 August 1980

View of south embankment taken from spillway bridge looking south. 27 August 1980

North approach channel wing wall and weir crest. 27 August 1980



South approach channel wing wall, weir crest and sluice gate control. 27 August 1980



North spillway wing wall and scour pad.

27 August 1980

South spillway wing wall and scour pad.

27 August 1980

Downstream face of spillway looking upstream.

27 August 1980

Downstream channel and pond looking east from bridge over spillway.

27 August 1980

APPENDIX 3

HYDROLOGICAL COMPUTATIONS

LANGAN ENGINEERING ASSOCIATES, INC.

HYDROLOGICAL COMPUTATIONS

CRANBERRY LAKE DAM

A. Location: Sussex County, N.J., Lubbers Run

B. Drainage area: 3.023 sq. mi (1927 acres)

C. Lake area: 191 acres

D. Classification: Size – intermediate
Hazard – high

E. Spillway Design Flood: PMF

F. PMP

1. Dam located in Zone 6 (near Zone 1 boundary)
PMP = 22.3 inches (for 200 sq. mi, 24 hr, 'all season envelope')*

2. PMF must be adjusted by a factor of 0.80** to account for basin size under 10 sq. mi

% Factor for ≤ 10 sq. mi			
Duration	Zone 1	Zone 6	Avg
0-6	111	113	112
0-12	123	123	123
0-24	133	132	132
0-48	142	142	142

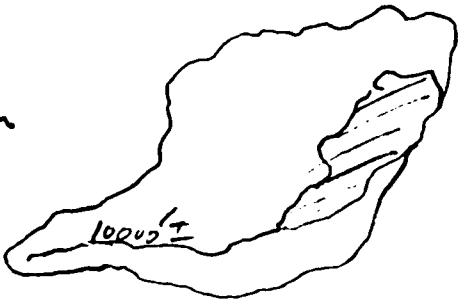
* HMR #33
** Page 48 "Design of Small Dams"

BY VAH DATE 8-17-81 Cranberry Lake Dam JOB NO. 80145
CKD RJ DATE 2/17/81 SHEET NO. 1 OF

LANGAN ENGINEERING ASSOCIATES, INC.

G. DETERMINE TIME OF CONCENTRATION

Majority of the watercourse is stream or channel flow



1. Estimate Tc based on average velocity and length

Ave slope (Y)
$= \frac{1140 - 760}{10000}$
$= 3.8\%$

From Fig 3-1, SCS TR-55
for grassed waterway, at 3.8% slope
velocity ≐ 3 fps

$Tc = \frac{10,000}{3 \times 60 \times 60} = 0.93$ hrs.

$L = 0.6\,Tc =$ 0.56 hrs.

2. Estimate Tc from curve number method
From Table 2-2 SCS TR-55
for soil group C (County soil survey – Sussex, N.J.)
use CN = 80

$S = \frac{1000}{CN} - 10 = \frac{1000}{80} - 10 = 2.5$

Lag time $L = \frac{\ell^{0.8}(S+1)^{0.7}}{1900(Y)^{0.5}}$ Eq. 3-2 TR-55

$= \frac{10000^{0.8}(3.5)^{0.7}}{1900\,(3.8)^{0.5}} =$ 1.03 hr.

use **L = 0.8 hrs**

BY TJC	DATE 2/12/81	Cranberry	JOB NO. 80145
CKD RWG	DATE 2/19/81		SHEET NO. 2 OF

LANGAN ENGINEERING ASSOCIATES, INC.

SPILLWAY CAPACITY

The spillway is similar to a broad crested weir therefore the equation $Q = CLH^{3/2}$ (where L = Length and H = head (ft above the crest) shall be used.

The crest of the weir which has a width of 3 feet is at elevation 760. The top of the weir is at the bottom of the walkway bridge (el. 763.1). Above this elevation, the flow becomes orifice flow and is therefore calculated using $Q = CA\sqrt{2gh}$

The top of the dam is at elevation 763.8 and weir flow is assumed for its length of 969 ft. Between elevations 763.8 and 765.4, the concrete parapet on the spillway becomes an obstructor; however; above 765.4 it will act as a weir.

See plans & sections for geometry of the dam & spillway.

A 2x2 sluice gate is blocked with rubble. ∴ for this analysis it is assumed inoperable.

BY NU DATE 9-15-81 Cranberry JOB NO.

CKD PY DATE 9/17/81 SHEET NO. 3 OF

ELEV.	2x2 SLUICE	SPILLWAY L=24' W=3'			EMBANKMENT L=969' W=10'			PARAPET L=31' W=7.6'			ΣQ cfs	NOTES
		H (ft)	C	Q_s (cfs)	H (ft)	C	Q_e (cfs)	H ft	C	Q_p (cfs)		
755.6		Weir Flow: $Q = CLH^{3/2}$										Bottom of 2x2 Sluice Gate
756.6		Orifice Flow: $Q = CA\sqrt{2gH}$										
757.6												TOP OF 2x2 Sluice Gate
760	GATE IS INOPERABLE IN CLOSED POSITION. RUBBLE BEHIND GATE	0	—	0							0	Top of Spillway
760.5		.5	2.63	22							22	
761		1.0	2.65	64							64	
762		2.0	2.72	185							185	
763		3.0	2.92	364							364	
763.1		3.1	2.93	384							384	Bottom of Bridge
763.8		*becomes 2.25	orifice .85	flow* 894	0	—	0				894	TOP OF DAM
764		2.45	11	933	.2	2.49	216				1149	
765		3.45	11	1107	1.2	2.69	3426				4533	
765.4		3.85	11	1169	1.6	2.64	5177	0	—	—	6346	Top of Parapet
766		4.95	11	1257	2.2	2.64	8348	.6	2.7	39	9644	
767		5.45	11	1391	3.2	2.64	14644	1.6	2.645	166	16201	
768		6.45	11	1513	4.2	2.64	22019	2.6	2.65	344	23876	

A = (3.64 x 12) 2 = 87.36

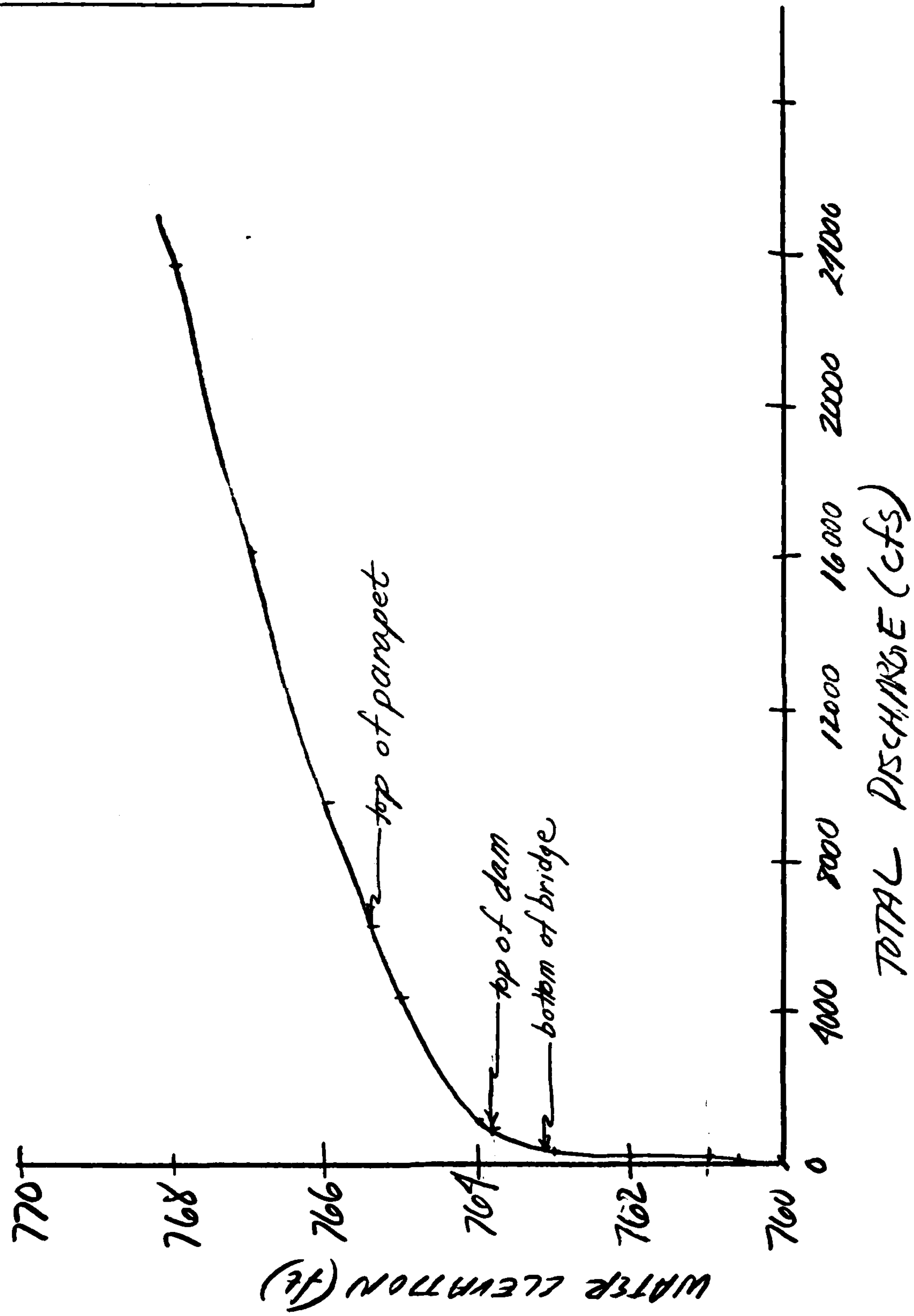
C values for weir flow obtained from table 5-3, King & Brater, Hdbk of Hyd.

C values for orifice flow from table 33, Small Dams

Sheet 1

SUMMARY OF SPILLWAY CAPACITY

LANGAN ENGINEERING ASSOCIATES, INC.



BY ka DATE 9/15/81 Cranberry JOB NO. 80195

CKD. DATE 9/17/81 Spillway Rating Curve SHEET NO. 5 OF

LANGAN ENGINEERING ASSOCIATES, INC.

Reservoir Storage Capacity

Assume a linear distribution for the area of the lake with elevation. Start at a zero storage at the crest of the spillway (El 760)

Area of Lake = 191 ac

Length of equivalent square = 2884.4 ft

Take average side slope: 1V : 2H

∴ for every foot of water above the crest of the spillway the length of the equivalent square increases by: 2×2×1 = 4'

Elevation (ft)	H (ft)	Length of Equiv. square (ft)	Area of Lake (acres)
760	0	2884.4	191
761	1	2888.4	191.5
762	2	2892.4	192.0
763	3	2896.4	192.6
763.8	3.8	2899.6	193.0
764	4	2900.4	193.1
765	5	2904.4	193.6
765.19	5.19	2905.2	193.8
766	6	2908.4	194.2
767	7	2912.4	194.7
768	8	2916.4	195.3

Storage capacity vs. elevation is calculated by HEC 1

BY VK DATE 9-19-80 Cranberry Lake JOB NO. 80195

CKD. PJ DATE 2/17/81 SHEET NO. 6 OF

LANGAN ENGINEERING ASSOCIATES, INC.

SUMMARY OF HYDROGRAPH & FLOOD ROUTING

1) Hydrograph & Routing calculated using HEC-1DB

2) PMF for Cranberry Lake is 12751 cfs (routed to 10992 cfs).

3) Routing of PMF indicates that the dam will overtop by 2.41 ft.

4) Routing of ½ PMF indicates that the dam will overtop by 1.04 ft.

BY VLL DATE 2-5-20 Cranberry Lake JOB NO. 8145

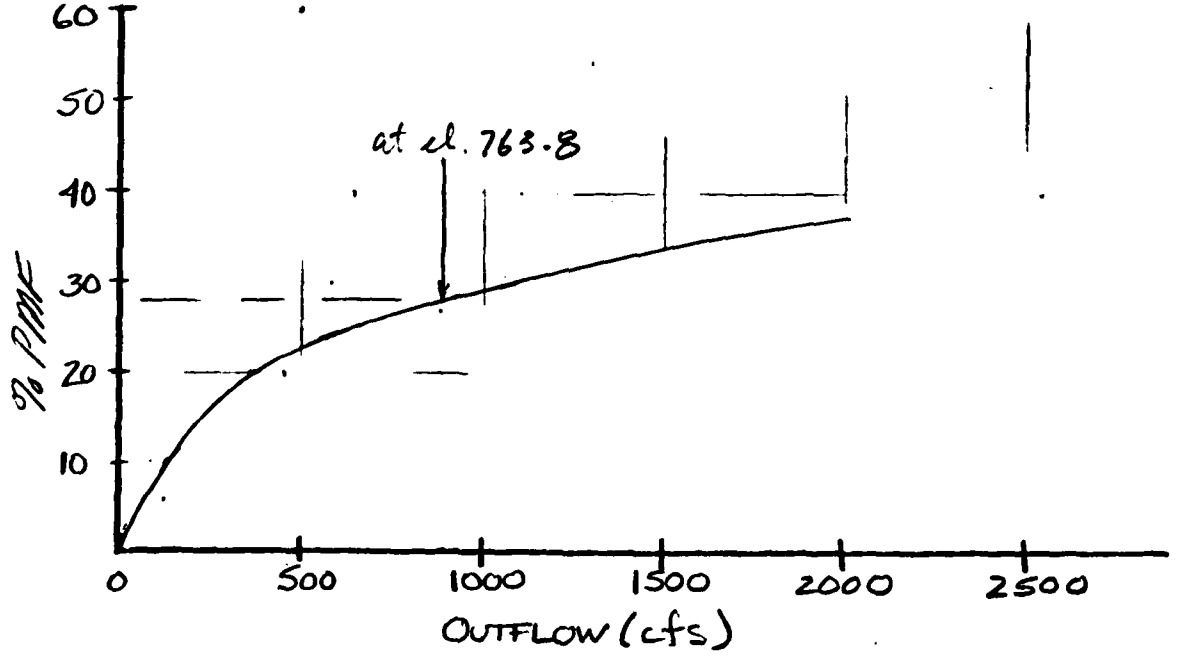
CKD BY DATE 2/11/81 SHEET NO. 7 OF

LANGAN ENGINEERING ASSOCIATES, INC.

OVERTOPPING POTENTIAL

1) Various % of PMF have been routed using HEC-1DB

2) Plot peak outflow vs. % PMF



3) Dam overtops at elev. 763.8 with Q = 894

∴ dam can pass approx 28 % of PMF.

BY VM DATE 8-17-80 Cranberry Lake JOB NO. 80145

CKD [illegible] DATE 8/19/80 SHEET NO. 8 OF

LANGAN ENGINEERING ASSOCIATES, INC.

DRAWDOWN ANALYSIS

1) Outlet Structures

There presently exists a 2'x2' sluice gate in the weir of the spillway. It is presently covered with rocks & debris which would cause it to be inoperable. A 12" Cast iron pipe & blowoff is located south of the spillway in the south embankment. A manhole & outlet from the pipe are located on the shore of the lower pond at the toe of the embankment. The structure is covered with brush and its operating condition is unknown

2.) Outlet Capacity - Sluice

invert of 2'x2' sluice = 755.6 & elev = 756.6
Spillway crest = 760
Apply equation for orifice flow $Q = cA\sqrt{2gh}$
where $c = .85$ for square edged entrance.

water elev. (ft)	Head (ft)	Q (cfs)
760	4.4	57
759	3.4	50
758	2.4	42
757	1.4	32
756	.4	17
755.6	0	0

BY VK DATE 9-23-80 Cranberry Lake JOB NO. 80145
CKD. [illegible] DATE 9/26/80 drawdown SHEET NO. 9 OF

LANGAN ENGINEERING ASSOCIATES, INC.

3) Outlet Capacity - 12" CI Pipe

a) Inv. assumed at 746.90
& elev = 747.4 (L=145ft ±)

b) Spillway Crest elev. 763.74

c) Pipe capacity based on $Q = C_p H^{1/2}$
where $C_p = A_p \sqrt{\frac{29}{1 + K_m + K_p L}}$

using $n = .015 : .025$ (use .025), $K_p = .1157$ (NEH Sect. 5 ES-42)
$A_p = .785 ft^2$, $K_m = .90$
$C_p = 1.46$, $Q = 1.46 H^{1/2}$

water elev (ft)	head (ft)	Q (cfs)
760	12.6	5.2
759	11.6	4.9
758	10.6	4.7
757	9.6	4.5
756	8.6	4.3
755.6	8.2	4.2
752	4.6	3.1
750	2.6	2.4
748	.6	1.1
746.9	0	0

BY VM DATE 9-23-86 Cranberry JOB NO. 80145
CKD MJ DATE 3/6/87 drawdown SHEET NO. 10 OF

LANGAN ENGINEERING ASSOCIATES, INC.

Elev. (ft)	$Q_{2\times2}$ (cfs)	$Q_{12'' CIP}$ (cfs)	ΣQ (cfs)
760	57	5	62
759	50	5	55
758	42	5	47
757	32	4	36
756	17	4	21
755.6	0	4	4
752	—	3	3
750	—	2	2
748	—	1	1
746.9	—	0	0

OUTLET CAPACITY SUMMARY

BY RU DATE 9-23-80 Cranberry JOB NO. 80145

CKD. [illegible] DATE 3/6/81 drawdown SHEET NO. 11 OF

LANGAN ENGINEERING ASSOCIATES, INC.

Storage Capacity

a) Use method of equivalent square as done in "Reservoir Storage Capacity"

b) Area at spillway crest elev 760 = 191 acres and has an equivalent square length of 2884.4 (2:1 slopes)

Water Elevation (ft)	Length of Equiv Sq (ft)	Area (ac)	ΔH (ft)	Increment Volume (ac-ft)	Volume
760	2884.4	191			
			1	191	2457
759	2880.4	190.5			
			1	190	2266
758	2876.4	189.9			
			1	189	2076
757	2872.4	189.4			
			1	189	1887
756	2868.4	188.9			
			.4	76	1698
755.6	2866.8	188.7			
			3.6	676	1622
752	2852.4	186.8			
			2	373	946
750	2844.4	185.7			
			2	370	573
748	2836.4	184.7			
			1.1	203	203
746.9	2832	184.1			

BY VR DATE 8/16/00 Cranberry Lake JOB NO. 80145

CKD [illegible] DATE 9/6/01 drawdown SHEET NO. 12 OF

DRAWDOWN CALCULATION

Elev. (ft)	Qout (cfs)	Qavg (cfs)	Qnet* (cfs)	Storage (ac ft)	Δt (hr)	ΣΔt (hr)	ΣΔt (days)
760	62						
		59	53	191	43.6	43.6	1.8
759	55						
		51	45	190	51.1	94.7	3.9
758	47						
		42	36	189	63.5	158.2	6.6
757	36						
		29	23	189	99.4	257.6	10.7
756	21						
		13	7	76	131.4	389	16.2
755.6	4						
			**	676	–		–
752	3						
			**	373	–		–
750	2						
			*x	370	–		–
748	1						
			**	203	–		–
746.9	0						

* Qnet = Qavg − Qin Assume 2 cfs/sq mi ** inflo > outflow not consid...

Qin = 2(3.02) = 6 cfs

Qnet = Qavg − 6

Lake can be drawndown 3 ft in about 7 days

BY: MK DATE: 12-25-80 Cranberry Lake JOB NO.: 80145

CKD: B DATE: 3/6/81 drawdown SHEET NO.: 13 OF: ____

DRAINAGE BASIN

CRANBERRY DAM

MAP SOURCE USGS

STANHOPE SCALE 1" = 2000'

PROJ NO 80145

SHEET ____ OF ____

LANGAN ENGINEERING ASSOCIATES, INC.

HEC-1

CRANBERRY LAKE DAM

```
1A1         CRANBERRY LAKE DAM (00325)
A2          INFLOW HYDROGRAPHY AND ROUTING
A3          N J DAM INSPECTIONS
B     290         0        10         0         0         0         0         0         0         0
B1      3
K       0         1                                                 1
K1    INFLOW HYDROGRAPH
M       1         2      3.01                              .80
P       0      22.3       112       123       132       142
T                                                           1       .15
W2              0.80
X      -2                   1
K       1         2                                                 1
K1    ROUTING COMPUTATIONS
Y                                       1
Y1      1                                                          -1
Y4    760     760.5       761       762       763     763.1     763.8       764       765     765.4
Y4    766       767       768
Y5      0        22        64       185       364       384       894      1149      4533      6346
Y5   9644     16201     23876
$A 191.0     191.5     192.0     192.6     193.1     193.6     194.2     194.7     195.3
$E    760       761       762       763       764       765       766       767       768
$$    760
$D  763.8
K      99
A
A
A
A
1           81/02/18. 09.22.21.      NOS 1.3 - L485.          EL4EDWC      STANDARD          MCAUTO - CYBER 175-3 1007.

                                    EEEEEEEEEEEE NN         NN DDDDDDDDDD
                                    EEEEEEEEEEEE NN         NN DDDDDDDDDDDD
                                    EE           NNN        NN DD        DDD
                                    EE           NNN        NN DD          DD
                                    EE           NNNN       NN DD          DD
                                    EE           NN NN      NN DD          DD
                                    EE           NN  NN     NN DD          DD
                                    EEEEEEEEEEE  NN   NN    NN DD          DD
                                    EEEEEEEEEEE  NN    NN   NN DD          DD
                                    EE           NN     NN NN DD          DD
                                    EE           NN      NNNN DD          DD
                                    EE           NN       NNN DD          DD
                                    EE           NN       NNN DD          DD
                                    EE           NN         NN DD        DDD
                                    EEEEEEEEEEEE NN         NN DDDDDDDDDDD
                                    EEEEEEEEEEEE NN         NN DDDDDDDDDD

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                              EEEEEEEEEEEE  CCCCCCCCCC  HH         HH  0000000000
                              EE           CCC        CC HH         HH 000      000
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EE           CC           HH        HH 00        00
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```
1**********************************
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION      JULY 1978
   LAST MODIFICATION  26 FEB 79
 **********************************
     1                A1         CRANBERRY LAKE DAM (00325)
     2                A2         INFLOW HYDROGRAPHY AND ROUTING
     3                A3         N J DAM INSPECTIONS
     4                B    290       0       10       0       0       0       0       0       0       0
     5                B1     3
     6                K      0       1                                       1
     7                K1   INFLOW HYDROGRAPH
     8                M      1       2     3.01                      .30
     9                P      0    22.3      112     123     132     142
    10                T                                                1     .15
    11                W2           0.80
    12                X     -2               1
    13                K      1       2                                       1
    14                K1   ROUTING COMPUTATIONS
    15                Y                              1
    16                Y1     1                                                -1
    17                Y4   760   760.5      761     762     763   763.1   763.8     764     765   765.4
    18                Y4   766     767      768
    19                Y5     0      22       64     185     364     384     894    1149    4533    6346
    20                Y5  9644   16201    23876
    21                $A 191.0   191.5    192.0   192.6   193.1   193.6   194.2   194.7   195.3
    22                $E   760     761      762     763     764     765     766     767     768
    23                $$   760
    24                $D 763.8
    25                K     99

1                          PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                                 RUNOFF HYDROGRAPH AT          1
                                 ROUTE HYDROGRAPH TO           2
                                 END OF NETWORK
```

```
1**********
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION      JULY 1978
   LAST MODIFICATION  26 FEB 79
 **********

 RUN  DATE= 81/02/18.
      TIME= 09.25.09.
```

CRANBERRY LAKE DAM (00325)
INFLOW HYDROGRAPHY AND ROUTING
N J DAM INSPECTIONS

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
290	0	10	0	0	0	0	0	0	0
			JOPER	NWT	LROPT	IRACE			
			3	0	0	0			

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	3.01	0.00	3.01	.80	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.30	112.00	123.00	132.00	142.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.15	0.00	0.00

UNIT HYDROGRAPH DATA

TC= 0.00 LAG= .80

RECESSION DATA

STRTQ= -2.00 QRCSN= 0.00 RTIOR= 1.00

UNIT HYDROGRAPH 26 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .80 VOL= 1.00

152.	466.	980.	1449.	1637.	1598.	1389.	1101.	761.	556.
414.	309.	225.	166.	121.	88.	65.	48.	36.	26.
19.	15.	11.	8.	5.	2.				

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.10	1	.00	0.00	.00	6.	1.02	.20	146	.02	0.00	.02	6.
1.01	.20	2	.00	0.00	.00	6.	1.02	.30	147	.02	0.00	.02	6.
1.01	.30	3	.00	0.00	.00	6.	1.02	.40	148	.02	0.00	.02	6.
1.01	.40	4	.00	0.00	.00	6.	1.02	.50	149	.02	0.00	.02	6.
1.01	.50	5	.00	0.00	.00	6.	1.02	1.00	150	.02	0.00	.02	6.
1.01	1.00	6	.00	0.00	.00	6.	1.02	1.10	151	.02	0.00	.02	6.
1.01	1.10	7	.00	0.00	.00	6.	1.02	1.20	152	.02	0.00	.02	6.

1.01	1.20	8	.00	0.00	.00	6.	1.02	1.30	153	.02	0.00	.02	6.
1.01	1.30	9	.00	0.00	.00	6.	1.02	1.40	154	.02	0.00	.02	6.
1.01	1.40	10	.00	0.00	.00	6.	1.02	1.50	155	.02	0.00	.02	6.
1.01	1.50	11	.00	0.00	.00	6.	1.02	2.00	156	.02	0.00	.02	6.
1.01	2.00	12	.00	0.00	.00	6.	1.02	2.10	157	.02	0.00	.02	6.
1.01	2.10	13	.00	0.00	.00	6.	1.02	2.20	158	.02	0.00	.02	6.
1.01	2.20	14	.00	0.00	.00	6.	1.02	2.30	159	.02	0.00	.02	6.
1.01	2.30	15	.00	0.00	.00	6.	1.02	2.40	160	.02	0.00	.02	6.
1.01	2.40	16	.00	0.00	.00	6.	1.02	2.50	161	.02	0.00	.02	6.
1.01	2.50	17	.00	0.00	.00	6.	1.02	3.00	162	.02	0.00	.02	6.
1.01	3.00	18	.00	0.00	.00	6.	1.02	3.10	163	.02	0.00	.02	6.
1.01	3.10	19	.00	0.00	.00	6.	1.02	3.20	164	.02	0.00	.02	6.
1.01	3.20	20	.00	0.00	.00	6.	1.02	3.30	165	.02	0.00	.02	6.
1.01	3.30	21	.00	0.00	.00	6.	1.02	3.40	166	.02	0.00	.02	6.
1.01	3.40	22	.00	0.00	.00	6.	1.02	3.50	167	.02	0.00	.02	6.
1.01	3.50	23	.00	0.00	.00	6.	1.02	4.00	168	.02	0.00	.02	6.
1.01	4.00	24	.00	0.00	.00	6.	1.02	4.10	169	.02	0.00	.02	6.
1.01	4.10	25	.00	0.00	.00	6.	1.02	4.20	170	.02	0.00	.02	6.
1.01	4.20	26	.00	0.00	.00	6.	1.02	4.30	171	.02	0.00	.02	6.
1.01	4.30	27	.00	0.00	.00	6.	1.02	4.40	172	.02	0.00	.02	6.
1.01	4.40	28	.00	0.00	.00	6.	1.02	4.50	173	.02	0.00	.02	6.
1.01	4.50	29	.00	0.00	.00	6.	1.02	5.00	174	.02	0.00	.02	6.
1.01	5.00	30	.00	0.00	.00	6.	1.02	5.10	175	.02	0.00	.02	6.
1.01	5.10	31	.00	0.00	.00	6.	1.02	5.20	176	.02	0.00	.02	6.
1.01	5.20	32	.00	0.00	.00	6.	1.02	5.30	177	.02	0.00	.02	6.
1.01	5.30	33	.00	0.00	.00	6.	1.02	5.40	178	.02	0.00	.02	6.
1.01	5.40	34	.00	0.00	.00	6.	1.02	5.50	179	.02	0.00	.02	6.
1.01	5.50	35	.00	0.00	.00	6.	1.02	6.00	180	.02	0.00	.02	6.
1.01	6.00	36	.00	0.00	.00	6.	1.02	6.10	181	.05	.03	.03	10.
1.01	6.10	37	.00	0.00	.00	6.	1.02	6.20	182	.05	.03	.03	24.
1.01	6.20	38	.00	0.00	.00	6.	1.02	6.30	183	.05	.03	.03	53.
1.01	6.30	39	.00	0.00	.00	6.	1.02	6.40	184	.05	.03	.03	96.
1.01	6.40	40	.00	0.00	.00	6.	1.02	6.50	185	.05	.03	.03	144.
1.01	6.50	41	.00	0.00	.00	6.	1.02	7.00	186	.05	.03	.03	191.
1.01	7.00	42	.00	0.00	.00	6.	1.02	7.10	187	.05	.03	.03	232.
1.01	7.10	43	.00	0.00	.00	6.	1.02	7.20	188	.05	.03	.03	265.
1.01	7.20	44	.00	0.00	.00	6.	1.02	7.30	189	.05	.03	.03	287.
1.01	7.30	45	.00	0.00	.00	6.	1.02	7.40	190	.05	.03	.03	304.
1.01	7.40	46	.00	0.00	.00	6.	1.02	7.50	191	.05	.03	.03	316.
1.01	7.50	47	.00	0.00	.00	6.	1.02	8.00	192	.05	.03	.03	325.
1.01	8.00	48	.00	0.00	.00	6.	1.02	8.10	193	.05	.03	.03	332.
1.01	8.10	49	.00	0.00	.00	6.	1.02	8.20	194	.05	.03	.03	337.
1.01	8.20	50	.00	0.00	.00	6.	1.02	8.30	195	.05	.03	.03	340.
1.01	8.30	51	.00	0.00	.00	6.	1.02	8.40	196	.05	.03	.03	343.
1.01	8.40	52	.00	0.00	.00	6.	1.02	8.50	197	.05	.03	.03	345.
1.01	8.50	53	.00	0.00	.00	6.	1.02	9.00	198	.05	.03	.03	346.
1.01	9.00	54	.00	0.00	.00	6.	1.02	9.10	199	.05	.03	.03	347.
1.01	9.10	55	.00	0.00	.00	6.	1.02	9.20	200	.05	.03	.03	348.
1.01	9.20	56	.00	0.00	.00	6.	1.02	9.30	201	.05	.03	.03	349.
1.01	9.30	57	.00	0.00	.00	6.	1.02	9.40	202	.05	.03	.03	349.
1.01	9.40	58	.00	0.00	.00	6.	1.02	9.50	203	.05	.03	.03	349.
1.01	9.50	59	.00	0.00	.00	6.	1.02	10.00	204	.05	.03	.03	350.
1.01	10.00	60	.00	0.00	.00	6.	1.02	10.10	205	.05	.03	.03	350.
1.01	10.10	61	.00	0.00	.00	6.	1.02	10.20	206	.05	.03	.03	350.
1.01	10.20	62	.00	0.00	.00	6.	1.02	10.30	207	.05	.03	.03	350.
1.01	10.30	63	.00	0.00	.00	6.	1.02	10.40	208	.05	.03	.03	350.
1.01	10.40	64	.00	0.00	.00	6.	1.02	10.50	209	.05	.03	.03	350.
1.01	10.50	65	.00	0.00	.00	6.	1.02	11.00	210	.05	.03	.03	350.
1.01	11.00	66	.00	0.00	.00	6.	1.02	11.10	211	.05	.03	.03	350.
1.01	11.10	67	.00	0.00	.00	6.	1.02	11.20	212	.05	.03	.03	350.
1.01	11.20	68	.00	0.00	.00	6.	1.02	11.30	213	.05	.03	.03	350.
1.01	11.30	69	.00	0.00	.00	6.	1.02	11.40	214	.05	.03	.03	350.
1.01	11.40	70	.00	0.00	.00	6.	1.02	11.50	215	.05	.03	.03	350.
1.01	11.50	71	.00	0.00	.00	6.	1.02	12.00	216	.05	.03	.03	350.
1.01	12.00	72	.00	0.00	.00	6.	1.02	12.10	217	.33	.31	.03	392.
1.01	12.10	73	.03	0.00	.03	6.	1.02	12.20	218	.33	.31	.01	922.

1.01	12.20	74	.03	0.00	.03	6.	1.02	12.30	219	.33	.31	.03	795.
1.01	12.30	75	.03	0.00	.03	6.	1.02	12.40	220	.33	.31	.03	1198.
1.01	12.40	76	.03	0.00	.03	6.	1.02	12.50	221	.33	.31	.03	1654.
1.01	12.50	77	.03	0.00	.03	6.	1.02	13.00	222	.33	.31	.03	2099.
1.01	13.00	78	.03	0.00	.03	6.	1.02	13.10	223	.40	.37	.03	2496.
1.01	13.10	79	.03	0.00	.03	6.	1.02	13.20	224	.40	.37	.03	2834.
1.01	13.20	80	.03	0.00	.03	6.	1.02	13.30	225	.40	.37	.03	3111.
1.01	13.30	81	.03	0.00	.03	6.	1.02	13.40	226	.40	.37	.03	3363.
1.01	13.40	82	.03	0.00	.03	6.	1.02	13.50	227	.40	.37	.03	3587.
1.01	13.50	83	.03	0.00	.03	6.	1.02	14.00	228	.40	.37	.03	3780.
1.01	14.00	84	.03	0.00	.03	6.	1.02	14.10	229	.50	.47	.03	3950.
1.01	14.10	85	.04	0.00	.04	6.	1.02	14.20	230	.50	.47	.03	4116.
1.01	14.20	86	.04	0.00	.04	6.	1.02	14.30	231	.50	.47	.03	4299.
1.01	14.30	87	.04	0.00	.04	6.	1.02	14.40	232	.50	.47	.03	4505.
1.01	14.40	88	.04	0.00	.04	6.	1.02	14.50	233	.50	.47	.03	4714.
1.01	14.50	89	.04	0.00	.04	6.	1.02	15.00	234	.50	.47	.03	4908.
1.01	15.00	90	.04	0.00	.04	6.	1.02	15.10	235	.46	.43	.03	5065.
1.01	15.10	91	.03	0.00	.03	6.	1.02	15.20	236	.76	.73	.03	5219.
1.01	15.20	92	.06	0.00	.06	6.	1.02	15.30	237	1.37	1.34	.03	5499.
1.01	15.30	93	.10	0.00	.10	6.	1.02	15.40	238	3.42	3.39	.03	6392.
1.01	15.40	94	.26	.19	.07	35.	1.02	15.50	239	.99	.96	.03	7991.
1.01	15.50	95	.07	.05	.03	103.	1.02	16.00	240	.61	.58	.03	10156.
1.01	16.00	96	.05	.02	.03	220.	1.02	16.10	241	.47	.44	.03	11991.
1.01	16.10	97	.04	.01	.03	343.	1.02	16.20	242	.47	.44	.03	12751.
1.01	16.20	98	.04	.01	.03	418.	1.02	16.30	243	.47	.44	.03	12519.
1.01	16.30	99	.04	.01	.03	440.	1.02	16.40	244	.47	.44	.03	11542.
1.01	16.40	100	.04	.01	.03	417.	1.02	16.50	245	.47	.44	.03	10207.
1.01	16.50	101	.04	.01	.03	368.	1.02	17.00	246	.47	.44	.03	8794.
1.01	17.00	102	.04	.01	.03	300.	1.02	17.10	247	.37	.34	.03	7798.
1.01	17.10	103	.03	.00	.03	251.	1.02	17.20	248	.37	.34	.03	7059.
1.01	17.20	104	.03	.00	.03	215.	1.02	17.30	249	.37	.34	.03	6450.
1.01	17.30	105	.03	.00	.03	184.	1.02	17.40	250	.37	.34	.03	5913.
1.01	17.40	106	.03	.00	.03	154.	1.02	17.50	251	.37	.34	.03	5467.
1.01	17.50	107	.03	.00	.03	128.	1.02	18.00	252	.37	.34	.03	5096.
1.01	18.00	108	.03	.00	.03	106.	1.02	18.10	253	.03	.00	.03	4750.
1.01	18.10	109	.00	0.00	.00	88.	1.02	18.20	254	.03	.00	.03	4370.
1.01	18.20	110	.00	0.00	.00	73.	1.02	18.30	255	.03	.00	.03	3880.
1.01	18.30	111	.00	0.00	.00	61.	1.02	18.40	256	.03	.00	.03	3272.
1.01	18.40	112	.00	0.00	.00	50.	1.02	18.50	257	.03	.00	.03	2630.
1.01	18.50	113	.00	0.00	.00	40.	1.02	19.00	258	.03	.00	.03	2025.
1.01	19.00	114	.00	0.00	.00	32.	1.02	19.10	259	.03	.00	.03	1509.
1.01	19.10	115	.00	0.00	.00	25.	1.02	19.20	260	.03	.00	.03	1100.
1.01	19.20	116	.00	0.00	.00	20.	1.02	19.30	261	.03	.00	.03	813.
1.01	19.30	117	.00	0.00	.00	16.	1.02	19.40	262	.03	.00	.03	600.
1.01	19.40	118	.00	0.00	.00	13.	1.02	19.50	263	.03	.00	.03	440.
1.01	19.50	119	.00	0.00	.00	11.	1.02	20.00	264	.03	.00	.03	324.
1.01	20.00	120	.00	0.00	.00	9.	1.02	20.10	265	.03	.00	.03	243.
1.01	20.10	121	.00	0.00	.00	8.	1.02	20.20	266	.03	.00	.03	183.
1.01	20.20	122	.00	0.00	.00	8.	1.02	20.30	267	.03	.00	.03	140.
1.01	20.30	123	.00	0.00	.00	7.	1.02	20.40	268	.03	.00	.03	109.
1.01	20.40	124	.00	0.00	.00	7.	1.02	20.50	269	.03	.00	.03	85.
1.01	20.50	125	.00	0.00	.00	7.	1.02	21.00	270	.03	.00	.03	68.
1.01	21.00	126	.00	0.00	.00	6.	1.02	21.10	271	.03	.00	.03	56.
1.01	21.10	127	.00	0.00	.00	6.	1.02	21.20	272	.03	.00	.03	47.
1.01	21.20	128	.00	0.00	.00	6.	1.02	21.30	273	.03	.00	.03	40.
1.01	21.30	129	.00	0.00	.00	6.	1.02	21.40	274	.03	.00	.03	35.
1.01	21.40	130	.00	0.00	.00	6.	1.02	21.50	275	.03	.00	.03	31.
1.01	21.50	131	.00	0.00	.00	6.	1.02	22.00	276	.03	.00	.03	29.
1.01	22.00	132	.00	0.00	.00	6.	1.02	22.10	277	.03	.00	.03	27.
1.01	22.10	133	.00	0.00	.00	6.	1.02	22.20	278	.03	.00	.03	27.
1.01	22.20	134	.00	0.00	.00	6.	1.02	22.30	279	.03	.00	.03	27.
1.01	22.30	135	.00	0.00	.00	6.	1.02	22.40	280	.03	.00	.03	27.
1.01	22.40	136	.00	0.00	.00	6.	1.02	22.50	281	.03	.00	.03	27.
1.01	22.50	137	.00	0.00	.00	6.	1.02	23.00	282	.03	.00	.03	27.
1.01	23.00	138	.00	0.00	.00	6.	1.02	23.10	283	.03	.00	.03	27.
1.01	23.10	139	.00	0.00	.00	6.	1.02	23.20	284	.03	.00	.03	27.

1.01	23.20	140	.00	0.00	.00	6.	1.02	23.30	285	.03	.00	.03	27.
1.01	23.30	141	.00	0.00	.00	6.	1.02	23.40	286	.03	.00	.03	27.
1.01	23.40	142	.00	0.00	.00	6.	1.02	23.50	287	.03	.00	.03	27.
1.01	23.50	143	.00	0.00	.00	6.	1.03	0.00	288	.03	.00	.03	27.
1.02	0.00	144	.00	0.00	.00	6.	1.03	.10	289	0.00	0.00	0.00	26.
1.02	.10	145	.02	0.00	.02	6.	1.03	.20	290	0.00	0.00	0.00	25.
									SUM	25.33	20.55	4.79	241013.
										(643.)(	522.)(	122.)(	6824.73)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	12751.	5904.	1640.	831.	240997.
CMS	361.	167.	46.	24.	6824.
INCHES		18.25	20.27	20.69	20.69
MM		463.43	514.94	525.49	525.49
AC-FT		2927.	3253.	3320.	3320.
THOUS CU M		3611.	4012.	4095.	4095.

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HYDROGRAPH ROUTING

ROUTING COMPUTATIONS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	-1

STAGE	760.00	760.50	761.00	762.00	763.00	763.10	763.80	764.00	765.00	765.40
	766.00	767.00	768.00							
FLOW	0.00	22.00	64.00	185.00	364.00	384.00	894.00	1149.00	4533.00	6346.00
	9644.00	16201.00	23876.00							
SURFACE AREA=	191.	192.	192.	193.	193.	194.	194.	195.	195.	
CAPACITY=	0.	191.	383.	575.	768.	961.	1155.	1350.	1545.	
ELEVATION=	760.	761.	762.	763.	764.	765.	766.	767.	768.	

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
760.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
763.8	0.0	0.0	0.

END-OF-PERIOD HYDROGRAPH ORDINATES

MO.DA	HR.MN	PERIOD	HOURS	INFLOW	OUTFLOW	STORAGE	STAGE
1.01	.10	1	.17	6.	0.	0.	760.0
1.01	.20	2	.33	6.	0.	0.	760.0
1.01	.30	3	.50	6.	0.	0.	760.0
1.01	.40	4	.67	6.	0.	0.	760.0
1.01	.50	5	.83	6.	0.	0.	760.0
1.01	1.00	6	1.00	6.	0.	0.	760.0
1.01	1.10	7	1.17	6.	0.	0.	760.0

1.01	1.20	8	1.33	6.	0.	1.	760.0
1.01	1.30	9	1.50	6.	0.	1.	760.0
1.01	1.40	10	1.67	6.	0.	1.	760.0
1.01	1.50	11	1.83	6.	0.	1.	760.0
1.01	2.00	12	2.00	6.	0.	1.	760.0
1.01	2.10	13	2.17	6.	0.	1.	760.0
1.01	2.20	14	2.33	6.	0.	1.	760.0
1.01	2.30	15	2.50	6.	0.	1.	760.0
1.01	2.40	16	2.67	6.	0.	1.	760.0
1.01	2.50	17	2.83	6.	0.	1.	760.0
1.01	3.00	18	3.00	6.	0.	1.	760.0
1.01	3.10	19	3.17	6.	0.	2.	760.0
1.01	3.20	20	3.33	6.	0.	2.	760.0
1.01	3.30	21	3.50	6.	0.	2.	760.0
1.01	3.40	22	3.67	6.	0.	2.	760.0
1.01	3.50	23	3.83	6.	0.	2.	760.0
1.01	4.00	24	4.00	6.	0.	2.	760.0
1.01	4.10	25	4.17	6.	0.	2.	760.0
1.01	4.20	26	4.33	6.	0.	2.	760.0
1.01	4.30	27	4.50	6.	0.	2.	760.0
1.01	4.40	28	4.67	6.	1.	2.	760.0
1.01	4.50	29	4.83	6.	1.	2.	760.0
1.01	5.00	30	5.00	6.	1.	2.	760.0
1.01	5.10	31	5.17	6.	1.	2.	760.0
1.01	5.20	32	5.33	6.	1.	3.	760.0
1.01	5.30	33	5.50	6.	1.	3.	760.0
1.01	5.40	34	5.67	6.	1.	3.	760.0
1.01	5.50	35	5.83	6.	1.	3.	760.0
1.01	6.00	36	6.00	6.	1.	3.	760.0
1.01	6.10	37	6.17	6.	1.	3.	760.0
1.01	6.20	38	6.33	6.	1.	3.	760.0
1.01	6.30	39	6.50	6.	1.	3.	760.0
1.01	6.40	40	6.67	6.	1.	3.	760.0
1.01	6.50	41	6.83	6.	1.	3.	760.0
1.01	7.00	42	7.00	6.	1.	3.	760.0
1.01	7.10	43	7.17	6.	1.	3.	760.0
1.01	7.20	44	7.33	6.	1.	3.	760.0
1.01	7.30	45	7.50	6.	1.	3.	760.0
1.01	7.40	46	7.67	6.	1.	4.	760.0
1.01	7.50	47	7.83	6.	1.	4.	760.0
1.01	8.00	48	8.00	6.	1.	4.	760.0
1.01	8.10	49	8.17	6.	1.	4.	760.0
1.01	8.20	50	8.33	6.	1.	4.	760.0
1.01	8.30	51	8.50	6.	1.	4.	760.0
1.01	8.40	52	8.67	6.	1.	4.	760.0
1.01	8.50	53	8.83	6.	1.	4.	760.0
1.01	9.00	54	9.00	6.	1.	4.	760.0
1.01	9.10	55	9.17	6.	1.	4.	760.0
1.01	9.20	56	9.33	6.	1.	4.	760.0
1.01	9.30	57	9.50	6.	1.	4.	760.0
1.01	9.40	58	9.67	6.	1.	4.	760.0
1.01	9.50	59	9.83	6.	1.	4.	760.0
1.01	10.00	60	10.00	6.	1.	5.	760.0
1.01	10.10	61	10.17	6.	1.	5.	760.0
1.01	10.20	62	10.33	6.	1.	5.	760.0
1.01	10.30	63	10.50	6.	1.	5.	760.0
1.01	10.40	64	10.67	6.	1.	5.	760.0
1.01	10.50	65	10.83	6.	1.	5.	760.0
1.01	11.00	66	11.00	6.	1.	5.	760.0
1.01	11.10	67	11.17	6.	1.	5.	760.0
1.01	11.20	68	11.33	6.	1.	5.	760.0
1.01	11.30	69	11.50	6.	1.	5.	760.0
1.01	11.40	70	11.67	6.	1.	5.	760.0
1.01	11.50	71	11.83	6.	1.	5.	760.0
1.01	12.00	72	12.00	6.	1.	5.	760.0
1.01	12.10	73	12.19	6.	1.	5.	760.0

1.01	12.20	74	12.33	6.	1.	5.	760.0
1.01	12.30	75	12.50	6.	1.	6.	760.0
1.01	12.40	76	12.67	6.	1.	6.	760.0
1.01	12.50	77	12.83	6.	1.	6.	760.0
1.01	13.00	78	13.00	6.	1.	6.	760.0
1.01	13.10	79	13.17	6.	1.	6.	760.0
1.01	13.20	80	13.33	6.	1.	6.	760.0
1.01	13.30	81	13.50	6.	1.	6.	760.0
1.01	13.40	82	13.67	6.	1.	6.	760.0
1.01	13.50	83	13.83	6.	1.	6.	760.0
1.01	14.00	84	14.00	6.	1.	6.	760.0
1.01	14.10	85	14.17	6.	1.	6.	760.0
1.01	14.20	86	14.33	6.	1.	6.	760.0
1.01	14.30	87	14.50	6.	1.	6.	760.0
1.01	14.40	88	14.67	6.	1.	6.	760.0
1.01	14.50	89	14.83	6.	1.	6.	760.0
1.01	15.00	90	15.00	6.	1.	6.	760.0
1.01	15.10	91	15.17	6.	2.	7.	760.0
1.01	15.20	92	15.33	6.	2.	7.	760.0
1.01	15.30	93	15.50	6.	2.	7.	760.0
1.01	15.40	94	15.67	35.	2.	7.	760.0
1.01	15.50	95	15.83	103.	2.	8.	760.0
1.01	16.00	96	16.00	220.	2.	10.	760.1
1.01	16.10	97	16.17	343.	3.	14.	760.1
1.01	16.20	98	16.33	418.	4.	19.	760.1
1.01	16.30	99	16.50	440.	6.	25.	760.1
1.01	16.40	100	16.67	417.	7.	31.	760.2
1.01	16.50	101	16.83	368.	8.	36.	760.2
1.01	17.00	102	17.00	300.	9.	41.	760.2
1.01	17.10	103	17.17	251.	10.	44.	760.2
1.01	17.20	104	17.33	215.	11.	47.	760.2
1.01	17.30	105	17.50	184.	11.	50.	760.3
1.01	17.40	106	17.67	154.	12.	52.	760.3
1.01	17.50	107	17.83	128.	12.	54.	760.3
1.01	18.00	108	18.00	106.	13.	55.	760.3
1.01	18.10	109	18.17	88.	13.	56.	760.3
1.01	18.20	110	18.33	73.	13.	57.	760.3
1.01	18.30	111	18.50	61.	13.	58.	760.3
1.01	18.40	112	18.67	50.	14.	59.	760.3
1.01	18.50	113	18.83	40.	14.	59.	760.3
1.01	19.00	114	19.00	32.	14.	59.	760.3
1.01	19.10	115	19.17	25.	14.	60.	760.3
1.01	19.20	116	19.33	20.	14.	60.	760.3
1.01	19.30	117	19.50	16.	14.	60.	760.3
1.01	19.40	118	19.67	13.	14.	60.	760.3
1.01	19.50	119	19.83	11.	14.	60.	760.3
1.01	20.00	120	20.00	9.	14.	60.	760.3
1.01	20.10	121	20.17	8.	14.	60.	760.3
1.01	20.20	122	20.33	8.	14.	60.	760.3
1.01	20.30	123	20.50	7.	14.	59.	760.3
1.01	20.40	124	20.67	7.	14.	59.	760.3
1.01	20.50	125	20.83	7.	14.	59.	760.3
1.01	21.00	126	21.00	6.	14.	59.	760.3
1.01	21.10	127	21.17	6.	14.	59.	760.3
1.01	21.20	128	21.33	6.	14.	59.	760.3
1.01	21.30	129	21.50	6.	14.	59.	760.3
1.01	21.40	130	21.67	6.	14.	59.	760.3
1.01	21.50	131	21.83	6.	14.	59.	760.3
1.01	22.00	132	22.00	6.	13.	59.	760.3
1.01	22.10	133	22.17	6.	13.	58.	760.3
1.01	22.20	134	22.33	6.	13.	58.	760.3
1.01	22.30	135	22.50	6.	13.	58.	760.3
1.01	22.40	136	22.67	6.	13.	58.	760.3
1.01	22.50	137	22.83	6.	13.	58.	760.3
1.01	23.00	138	23.00	6.	13.	58.	760.3
1.01	23.10	139	23.17	6.	13.	58.	760.3

1.01	23.20	140	23.33	6.	13.	58.	760.3
1.01	23.30	141	23.50	6.	13.	58.	760.3
1.01	23.40	142	23.67	6.	13.	58.	760.3
1.01	23.50	143	23.83	6.	13.	57.	760.3
1.02	0.00	144	24.00	6.	13.	57.	760.3
1.02	.10	145	24.17	6.	13.	57.	760.3
1.02	.20	146	24.33	6.	13.	57.	760.3
1.02	.30	147	24.50	6.	13.	57.	760.3
1.02	.40	148	24.67	6.	13.	57.	760.3
1.02	.50	149	24.83	6.	13.	57.	760.3
1.02	1.00	150	25.00	6.	13.	57.	760.3
1.02	1.10	151	25.17	6.	13.	57.	760.3
1.02	1.20	152	25.33	6.	13.	57.	760.3
1.02	1.30	153	25.50	6.	13.	56.	760.3
1.02	1.40	154	25.67	6.	13.	56.	760.3
1.02	1.50	155	25.83	6.	13.	56.	760.3
1.02	2.00	156	26.00	6.	13.	56.	760.3
1.02	2.10	157	26.17	6.	13.	56.	760.3
1.02	2.20	158	26.33	6.	13.	56.	760.3
1.02	2.30	159	26.50	6.	13.	56.	760.3
1.02	2.40	160	26.67	6.	13.	56.	760.3
1.02	2.50	161	26.83	6.	13.	56.	760.3
1.02	3.00	162	27.00	6.	13.	56.	760.3
1.02	3.10	163	27.17	6.	13.	56.	760.3
1.02	3.20	164	27.33	6.	13.	55.	760.3
1.02	3.30	165	27.50	6.	13.	55.	760.3
1.02	3.40	166	27.67	6.	13.	55.	760.3
1.02	3.50	167	27.83	6.	13.	55.	760.3
1.02	4.00	168	28.00	6.	13.	55.	760.3
1.02	4.10	169	28.17	6.	13.	55.	760.3
1.02	4.20	170	28.33	6.	13.	55.	760.3
1.02	4.30	171	28.50	6.	13.	55.	760.3
1.02	4.40	172	28.67	6.	13.	55.	760.3
1.02	4.50	173	28.83	6.	13.	55.	760.3
1.02	5.00	174	29.00	6.	13.	55.	760.3
1.02	5.10	175	29.17	6.	13.	54.	760.3
1.02	5.20	176	29.33	6.	13.	54.	760.3
1.02	5.30	177	29.50	6.	12.	54.	760.3
1.02	5.40	178	29.67	6.	12.	54.	760.3
1.02	5.50	179	29.83	6.	12.	54.	760.3
1.02	6.00	180	30.00	6.	12.	54.	760.3
1.02	6.10	181	30.17	10.	12.	54.	760.3
1.02	6.20	182	30.33	24.	12.	54.	760.3
1.02	6.30	183	30.50	53.	13.	54.	760.3
1.02	6.40	184	30.67	96.	13.	55.	760.3
1.02	6.50	185	30.83	144.	13.	57.	760.3
1.02	7.00	186	31.00	191.	14.	59.	760.3
1.02	7.10	187	31.17	232.	14.	62.	760.3
1.02	7.20	188	31.33	265.	15.	65.	760.3
1.02	7.30	189	31.50	287.	16.	68.	760.4
1.02	7.40	190	31.67	304.	17.	72.	760.4
1.02	7.50	191	31.83	316.	18.	76.	760.4
1.02	8.00	192	32.00	325.	19.	80.	760.4
1.02	8.10	193	32.17	332.	19.	85.	760.4
1.02	8.20	194	32.33	337.	20.	89.	760.5
1.02	8.30	195	32.50	340.	21.	93.	760.5
1.02	8.40	196	32.67	343.	23.	98.	760.5
1.02	8.50	197	32.83	345.	25.	102.	760.5
1.02	9.00	198	33.00	346.	27.	107.	760.6
1.02	9.10	199	33.17	347.	29.	111.	760.6

1.02	10.20	206	34.33	350.	42.	141.	760.7
1.02	10.30	207	34.50	350.	44.	145.	760.8
1.02	10.40	208	34.67	350.	46.	150.	760.8
1.02	10.50	209	34.83	350.	48.	154.	760.8
1.02	11.00	210	35.00	350.	49.	158.	760.8
1.02	11.10	211	35.17	350.	51.	162.	760.8
1.02	11.20	212	35.33	350.	53.	166.	760.9
1.02	11.30	213	35.50	350.	55.	170.	760.9
1.02	11.40	214	35.67	350.	57.	174.	760.9
1.02	11.50	215	35.83	350.	58.	178.	760.9
1.02	12.00	216	36.00	350.	60.	182.	761.0
1.02	12.10	217	36.17	392.	62.	187.	761.0
1.02	12.20	218	36.33	522.	64.	192.	761.0
1.02	12.30	219	36.50	795.	70.	200.	761.0
1.02	12.40	220	36.67	1198.	78.	213.	761.1
1.02	12.50	221	36.83	1654.	89.	231.	761.2
1.02	13.00	222	37.00	2099.	105.	256.	761.3
1.02	13.10	223	37.17	2496.	124.	286.	761.5
1.02	13.20	224	37.33	2834.	144.	321.	761.7
1.02	13.30	225	37.50	3111.	170.	360.	761.9
1.02	13.40	226	37.67	3363.	202.	402.	762.1
1.02	13.50	227	37.83	3587.	244.	446.	762.3
1.02	14.00	228	38.00	3780.	288.	493.	762.6
1.02	14.10	229	38.17	3950.	333.	542.	762.8
1.02	14.20	230	38.33	4116.	382.	593.	763.1
1.02	14.30	231	38.50	4299.	572.	644.	763.4
1.02	14.40	232	38.67	4505.	767.	696.	763.6
1.02	14.50	233	38.83	4714.	1010.	747.	763.9
1.02	15.00	234	39.00	4908.	1623.	795.	764.1
1.02	15.10	235	39.17	5065.	2347.	837.	764.4
1.02	15.20	236	39.33	5219.	2948.	871.	764.5
1.02	15.30	237	39.50	5499.	3466.	901.	764.7
1.02	15.40	238	39.67	6392.	3999.	931.	764.8
1.02	15.50	239	39.83	7991.	4730.	970.	765.0
1.02	16.00	240	40.00	10156.	5936.	1021.	765.3
1.02	16.10	241	40.17	11991.	7541.	1081.	765.6
1.02	16.20	242	40.33	12751.	9118.	1137.	765.9
1.02	16.30	243	40.50	12519.	10363.	1177.	766.1
1.02	16.40	244	40.67	11542.	10992.	1195.	766.2
1.02	16.50	245	40.83	10207.	10947.	1194.	766.2
1.02	17.00	246	41.00	8794.	10402.	1178.	766.1
1.02	17.10	247	41.17	7798.	9612.	1154.	766.0
1.02	17.20	248	41.33	7059.	8900.	1129.	765.9
1.02	17.30	249	41.50	6450.	8200.	1104.	765.7
1.02	17.40	250	41.67	5913.	7541.	1081.	765.6
1.02	17.50	251	41.83	5467.	6937.	1060.	765.5
1.02	18.00	252	42.00	5096.	6396.	1041.	765.4
1.02	18.10	253	42.17	4750.	5980.	1023.	765.3
1.02	18.20	254	42.33	4370.	5587.	1007.	765.2
1.02	18.30	255	42.50	3880.	5181.	989.	765.1
1.02	18.40	256	42.67	3272.	4736.	970.	765.0
1.02	18.50	257	42.83	2630.	4307.	949.	764.9
1.02	19.00	258	43.00	2025.	3882.	924.	764.8
1.02	19.10	259	43.17	1509.	3427.	898.	764.7
1.02	19.20	260	43.33	1100.	2971.	872.	764.5
1.02	19.30	261	43.50	813.	2538.	847.	764.4
1.02	19.40	262	43.67	600.	2144.	825.	764.3
1.02	19.50	263	43.83	440.	1794.	805.	764.2
1.02	20.00	264	44.00	324.	1490.	788.	764.1
1.02	20.10	265	44.17	243.	1230.	773.	764.0
1.02	20.20	266	44.33	183.	1094.	760.	764.0
1.02	20.30	267	44.50	140.	1013.	748.	763.9
1.02	20.40	268	44.67	109.	936.	736.	763.8
1.02	20.50	269	44.83	85.	876.	725.	763.8
1.02	21.00	270	45.00	68.	816.	714.	763.7
1.02	21.10	271	45.17	56.	792.	704.	763.7

1.02	21.20	272	45.33	47.	759.	694.	763.6
1.02	21.30	273	45.50	40.	723.	684.	763.6
1.02	21.40	274	45.67	35.	688.	675.	763.5
1.02	21.50	275	45.83	31.	655.	666.	763.5
1.02	22.00	276	46.00	29.	623.	658.	763.4
1.02	22.10	277	46.17	27.	593.	650.	763.4
1.02	22.20	278	46.33	27.	565.	642.	763.3
1.02	22.30	279	46.50	27.	537.	635.	763.3
1.02	22.40	280	46.67	27.	511.	628.	763.3
1.02	22.50	281	46.83	27.	487.	622.	763.2
1.02	23.00	282	47.00	27.	463.	616.	763.2
1.02	23.10	283	47.17	27.	441.	610.	763.2
1.02	23.20	284	47.33	27.	420.	604.	763.1
1.02	23.30	285	47.50	27.	400.	599.	763.1
1.02	23.40	286	47.67	27.	383.	594.	763.1
1.02	23.50	287	47.83	27.	378.	589.	763.1
1.03	0.00	288	48.00	27.	373.	584.	763.0
1.03	.10	289	48.17	26.	368.	579.	763.0
1.03	.20	290	48.33	25.	363.	575.	763.0

PEAK OUTFLOW IS 10992. AT TIME 40.67 HOURS

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	10992.	5035.	1379.	687.	199328.
CMS	311.	143.	39.	19.	5644.
INCHES		15.56	17.05	17.11	17.11
MM		395.22	433.12	434.63	434.63
AC-FT		2497.	2736.	2746.	2746.
THOUS CU M		3079.	3375.	3387.	3387.

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RUNOFF SUMMARY, AVERAGE FLOW IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES(SQUARE KILOMETERS)

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	1	12751.	5904.	1640.	831.	3.01
		(361.08)(	167.18)(	46.44)(	23.53)(	7.80)
ROUTED TO	2	10992.	5035.	1379.	687.	3.01
		(311.25)(	142.57)(	39.06)(	19.46)(	7.80)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	760.00	760.00	763.80
STORAGE	0.	0.	730.
OUTFLOW	0.	0.	894.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
0.00	766.21	2.41	1195.	10992.	6.00	40.67	0.00

1**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978

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1A1         CRANBERRY LAKE DAM (00325)
A2          INFLOW HYDROGRAPHY AND ROUTING
A3          N J DAM INSPECTIONS
B      290        0       10        0        0        0        0        0        4        0
B1       5
J        1        5        1
J1      .1       .2       .3       .4       .5
K        0        1                                          1
K1   INFLOW HYDROGRAPH
M        1        2     3.01                             .80
P        0     22.3      112      123      132      142
T                                                          1      .15
W2            0.80
X       -2                 1
K        1        2                                         1
K1   ROUTING COMPUTATIONS
Y                                  1
Y1       1                                                        -1
Y4     760    760.5      761      762      763    763.1    763.8      764      765    765.4
Y4     766      767      768
Y5       0       22       64      185      364      384      894     1149     4533     6346
Y5    9644    16201    23876
$A  191.0    191.5    192.0    192.6    193.1    193.6    194.2    194.7    195.3
$E    760      761      762      763      764      765      766      767      768
$$    760
$D  763.8
N       99
A
A
A
A
A
A
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1 81/02/18. 12.24.40. NOS 1.3 - L485. EL4EPCO STANDARD MCAUTO - CYBER 175-3 1007.

```
EEEEEEEEEEEE NN         NN DDDDDDDDDD
EEEEEEEEEEEE NN         NN DDDDDDDDDDD
EE           NNN        NN DD        DDD
EE           NNN        NN DD         DD
EE           NNNN       NN DD         DD
EE           NN NN      NN DD         DD
EE           NN  NN     NN DD         DD
EEEEEEEEEEE  NN   NN    NN DD         DD
EEEEEEEEEEE  NN    NN   NN DD         DD
EE           NN     NN NN DD         DD
EE           NN      NNNN DD         DD
EE           NN       NNN DD         DD
EE           NN        NN DD        DDD
EEEEEEEEEEEE NN         NN DDDDDDDDDDD
EEEEEEEEEEEE NN         NN DDDDDDDDDD
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EEEEEEEEEEEE    CCCCCCCC    HH          HH    00000000
EEEEEEEEEEEE   CCCCCCCCCC   HH          HH   0000000000
EE            CCC        CC HH          HH 000      000
EE            CC            HH          HH 00        00
EE            CC            HH          HH 00        00
EE            CC            HH          HH 00        00
EE            CC            HH          HH 00        00
EEEEEEEEEEE   CC            HHHHHHHHHHHHH 00        00
EEEEEEEEEEE   CC            HHHHHHHHHHHHH 00        00
EE            CC            HH          HH 00        00
EE            CC            HH          HH 00        00
EE            CC            HH          HH 00        00
EE            CC            HH          HH 00        00
EE            CCC        CC HH          HH 000      000
EEEEEEEEEEEE   CCCCCCCCCC   HH          HH   0000000000
EEEEEEEEEEEE    CCCCCCCC    HH          HH    00000000
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1**********************************
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION      JULY 1978
   LAST MODIFICATION  26 FEB 79
**********************************
1                              PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

                                      RUNOFF HYDROGRAPH AT          1
                                      ROUTE HYDROGRAPH TO           2
                                      END OF NETWORK


1**********************************
 FLOOD HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION      JULY 1978
   LAST MODIFICATION  26 FEB 79
**********************************

 RUN  DATE= 81/02/18.
      TIME= 12.24.46.


                              CRANBERRY LAKE DAM (00323)
                              INFLOW HYDROGRAPHY AND ROUTING
                              N J DAM INSPECTIONS

                                                JOB SPECIFICATION
                        NQ      NHR     NMIN     IDAY     IHR     IMIN    METRC     IPLT     IPRT    NSTAN
                       290        0       10        0       0        0        0        0        4        0
                                                JOPER      NWT    LROPT    TRACE
                                                    5        0        0        0
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MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LKTIO= 1

RTIOS= .10 .20 .30 .40 .50

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SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	3.01	0.00	3.01	.80	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.30	112.00	123.00	132.00	142.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.15	0.00	0.00

UNIT HYDROGRAPH DATA

TC= 0.00 LAG= .80

RECESSION DATA

STRTQ= -2.00 QRCSN= 0.00 RTIOR= 1.00

0
END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	25.33	20.55	4.79	241013.
										(643.)(522.)(122.)(6824.73)			

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HYDROGRAPH ROUTING

ROUTING COMPUTATIONS

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	-1

STAGE	760.00	760.50	761.00	762.00	763.00	763.10	763.80	764.00	765.00	765.40
	766.00	767.00	768.00							
FLOW	0.00	22.00	64.00	185.00	364.00	384.00	894.00	1149.00	4533.00	6346.00
	9644.00	16201.00	23876.00							
SURFACE AREA=	191.	192.	192.	193.	193.	194.	194.	195.	195.	

CAPACITY=	0.	191.	383.	575.	768.	961.	1155.	1350.	1545.
ELEVATION=	760.	761.	762.	763.	764.	765.	766.	767.	768.

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
760.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COCD	EXPD	DAMWID
763.8	0.0	0.0	0.

PEAK OUTFLOW IS 128. AT TIME 43.33 HOURS

PEAK OUTFLOW IS 351. AT TIME 43.17 HOURS

PEAK OUTFLOW IS 1088. AT TIME 42.50 HOURS

PEAK OUTFLOW IS 2549. AT TIME 41.50 HOURS

PEAK OUTFLOW IS 3988. AT TIME 41.17 HOURS

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PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .10	RATIO 2 .20	RATIO 3 .30	RATIO 4 .40	RATIO 5 .50
HYDROGRAPH AT	1	3.01	1	1275.	2550.	3825.	5101.	6376.
	(	7.80)	(	36.11)(	72.22)(	108.32)(	144.43)(	180.54)(
ROUTED TO	2	3.01	1	128.	351.	1088.	2549.	3988.
	(	7.80)	(	3.61)(	9.93)(	30.82)(	72.17)(	112.93)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	760.00	760.00	763.80
STORAGE	0.	0.	730.
OUTFLOW	0.	0.	894.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	761.52	0.00	292.	128.	0.00	43.33	0.00
.20	762.92	0.00	561.	351.	0.00	43.17	0.00
.30	763.95	.15	759.	1088.	1.67	42.50	0.00
.40	764.41	.61	848.	2549.	3.33	41.50	0.00

APPENDIX 4

REFERENCES

APPENDIX 4

REFERENCES
CRANBERRY LAKE DAM

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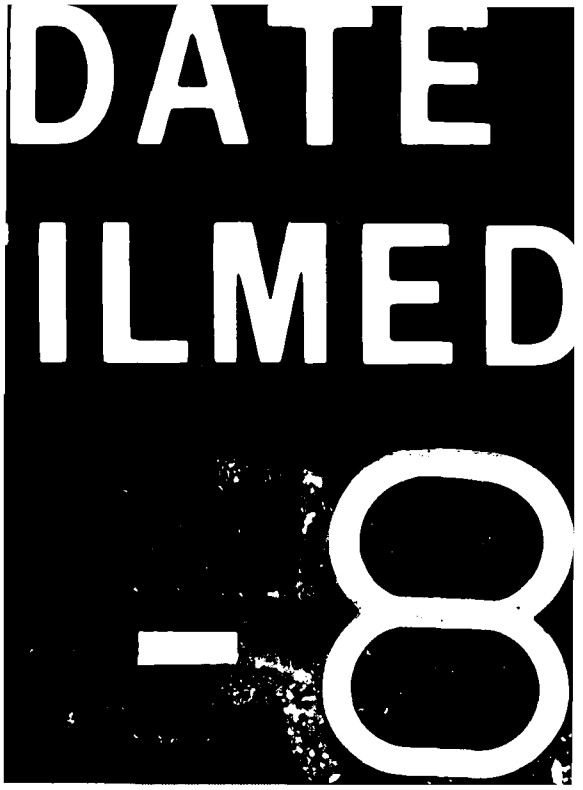
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